Municipal and County Engineering

DESIGN, CONSTRUCTION, OPERATION AND MAINTENANCE OF ALL PUBLIC WORKS

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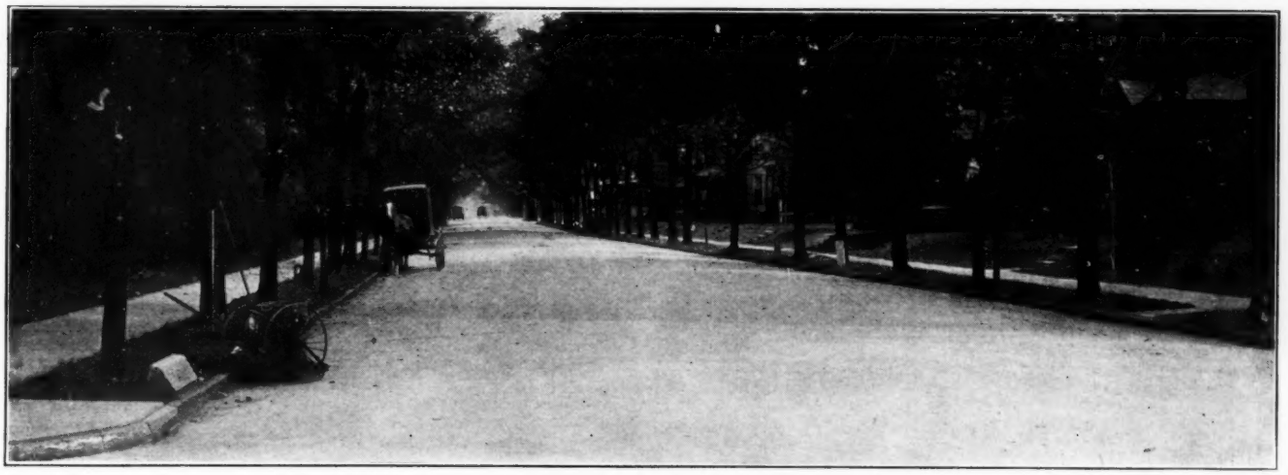

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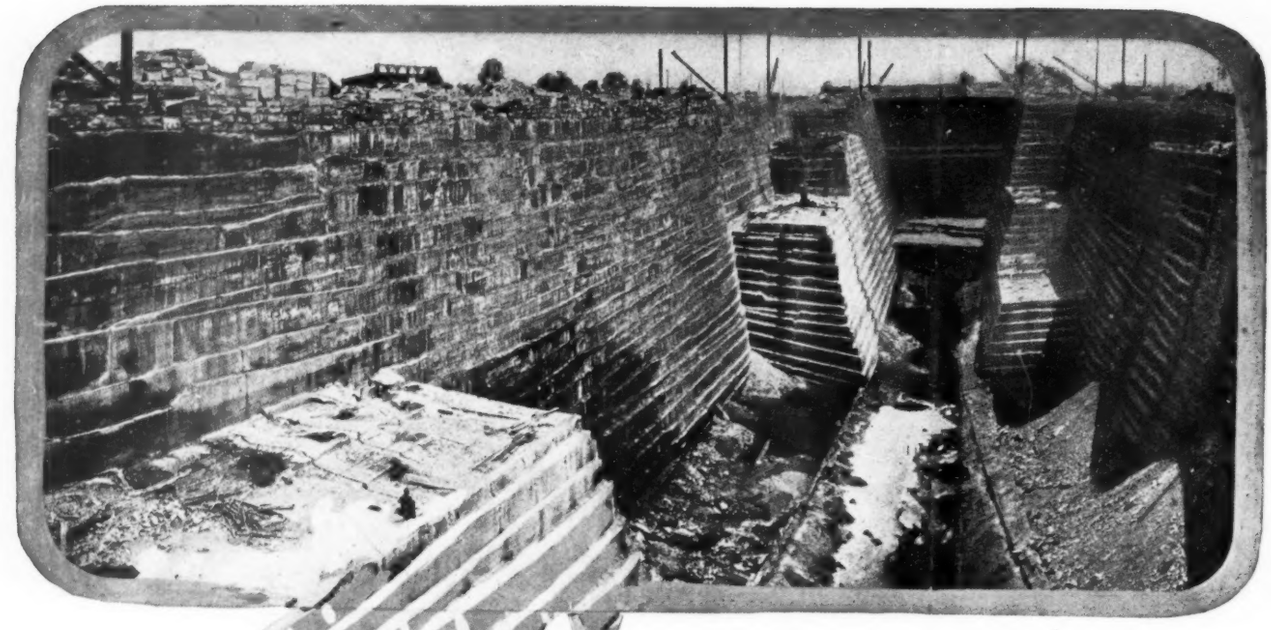

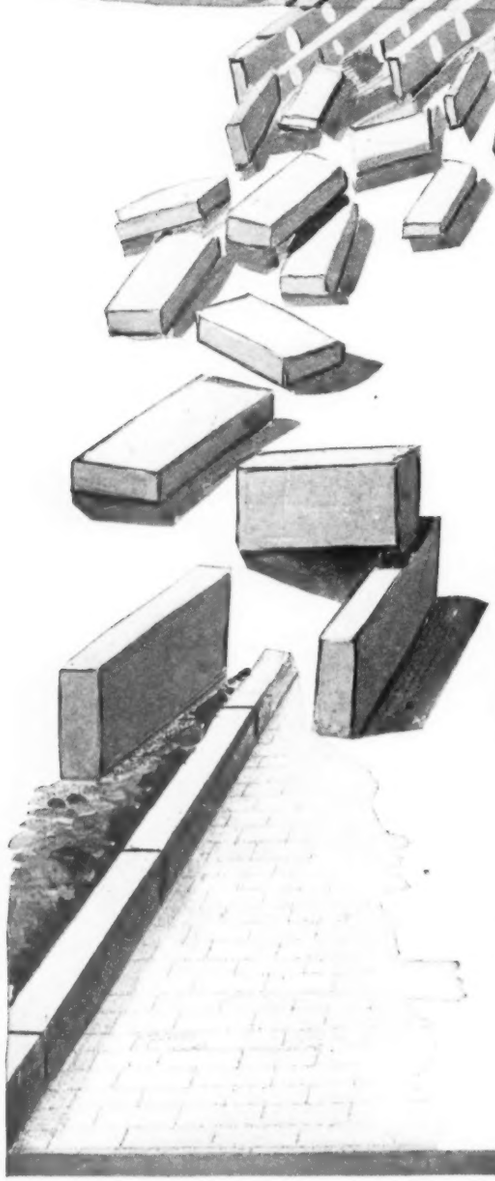

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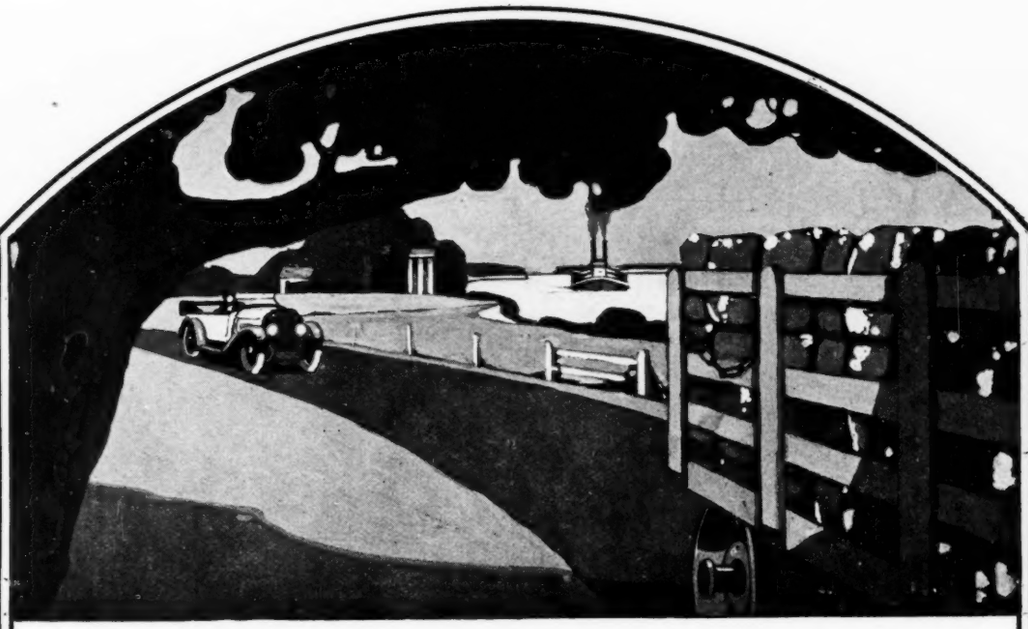

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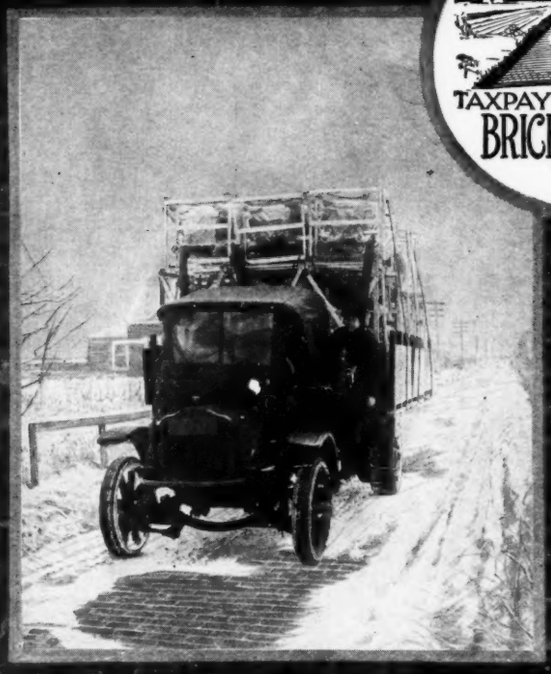

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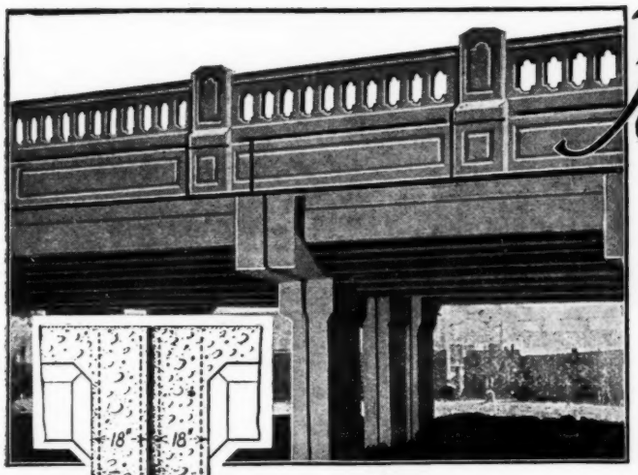

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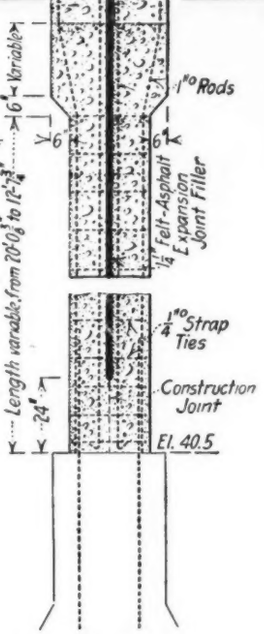

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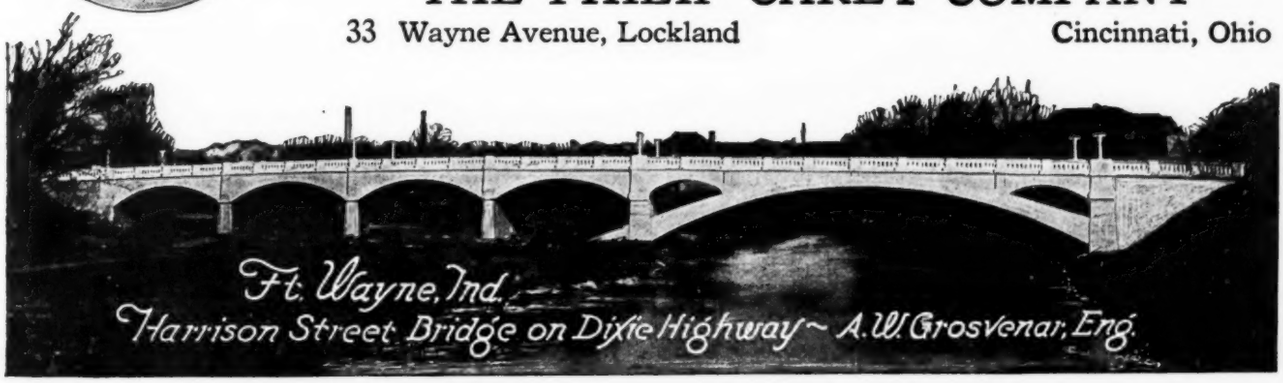

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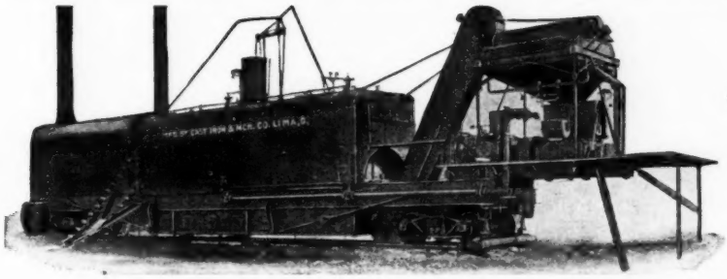

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Heating Wagons (Oil and Tar).
Littleford Bros.

Hoists (Concrete, Gasoline and Hand).
Pawling and Harnischfeger

Hoists, Electric.
Pawling and Harnischfeger.

Hoists, Steam.
Lewis-Hall Iron Works.

Hot Mixers.
F. C. Austin Co., Inc.
Barber Asphalt Paving Co.

Hydrants.
Flower Valve Mfg. Co.

Inlets (Sewer).
Dee Co., Wm. E.
Madison Foundry Co.

Insulating Material.
The Barrett Co.
H. H. Robertson Co.

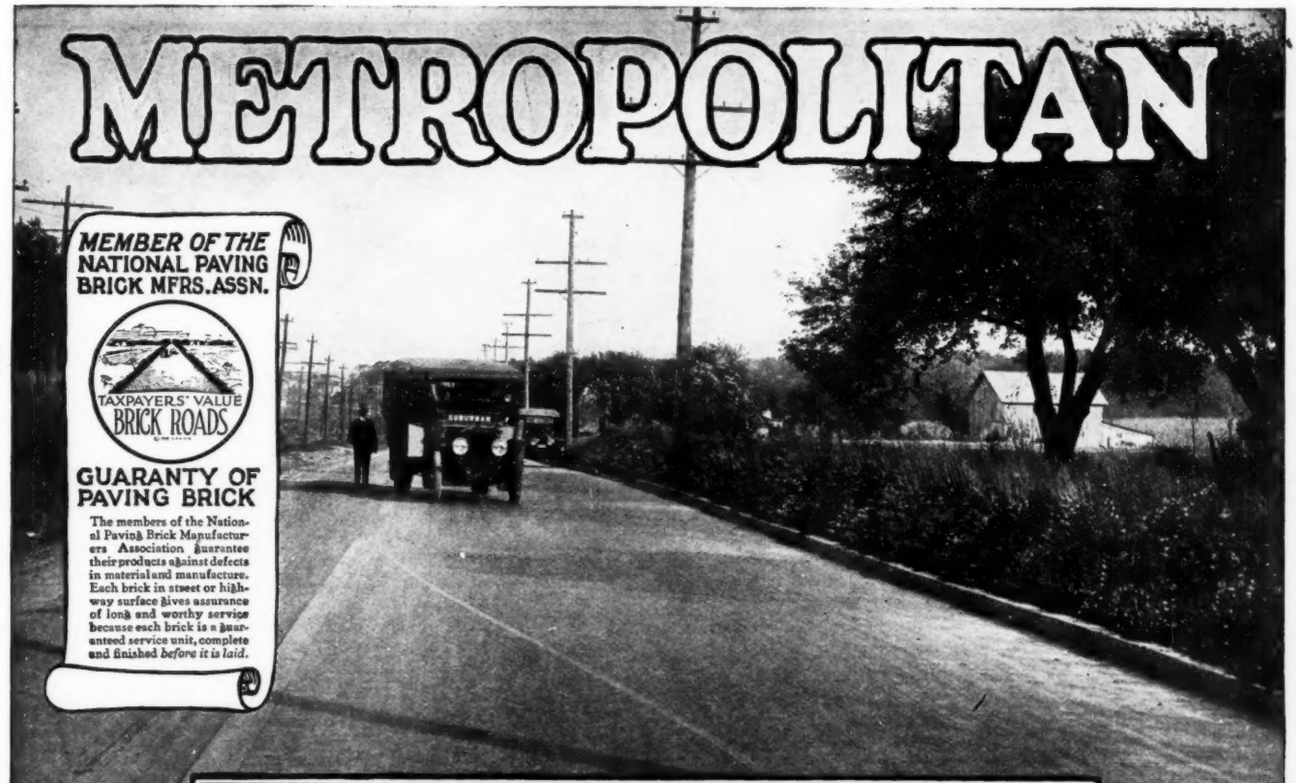
Joint Fillers (Paving).
The Barrett Co.
Philip Carey Co., The.

Kettles (Portable).
Barber Asphalt Paving Co.
Cummer & Son Co., The F. D.

Manhole Covers.
Madison Foundry Co.
Dee Co., Wm. E.

Meter Boxes.
Ford Meter Box Co., The

METROPOLITAN



MEMBER OF THE NATIONAL PAVING BRICK MFRS. ASSN.

TAXPAYERS' VALUE BRICK ROADS

GUARANTY OF PAVING BRICK

The members of the National Paving Brick Manufacturers Association guarantee their products against defects in material and manufacture. Each brick in street or highway surface gives assurance of long and worthy service because each brick is a guaranteed service unit, complete and finished *before it is laid*.

First Cost? or Cost by the Year?

How strange it always seems to those who really *know pavements* that people still argue about first cost all by itself!

First cost figures, considered apart from maintenance cost, have as much to do with deciding on a pavement as the price of astronomical telescopes.

Every engineer and every experienced public official knows that a road which costs "half as much" to build usually has cost "twice as much" at the end of ten years, and has been out of service a good part of the time, at that.

The public must have education on the road question—*now!*

And because sound knowledge of the road question leads straight to the Brick Pavement, we are doing our share toward making plain to the public the broad truths about roads and streets.

By this broad policy we shall benefit engineers and officials who want to give the public what it ought to have. And we believe we shall thus reinforce the just faith you have shown so amply in the fine products and unequalled service facilities of METROPOLITAN, the largest manufacturer of Paving Brick, or Block, in the world.

METROPOLITAN PAVING BRICK COMPANY

CANTON OHIO

"METROPOLITAN" BRICK PAVEMENTS

BUYERS' GUIDE

Mixers, Asphalt.
F. C. Austin Co., Inc.
Barber Asphalt Paving Co.
Cummer & Sons Co., The F. D.

Mixers, Concrete.
F. C. Austin Co., Inc.

Molds (Pipe & Culvert).
Heltzel Steel Form & Iron Co.

Motor Fire Apparatus.
Acme Motor Truck Co.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co.
The Gramm-Bernstein Motor Truck Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Pierce-Arrow Motor Car Co.
Reo Motor Car Co.
Service Motor Truck Co.
J. C. Wilson Co.

Motor Trucks.
Acme Motor Truck Co.
Autocar Co.
Duplex Truck Co.
Federal Motor Truck Co.
The Gramm-Bernstein Motor Truck Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Pierce-Arrow Motor Car Co.
Reo Motor Car Co.
Service Motor Truck Co.
J. C. Wilson Co.

Motor Truck Flushers, Sprinklers and Oilers.
Acme Motor Truck Co.
Autocar Co.
F. C. Austin Co., Inc.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co., The
The Gramm-Bernstein Motor Truck Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Pierce-Arrow Motor Car Co.
Reo Motor Car Co.
Service Motor Truck Co.
J. C. Wilson Co.

Municipal Castings.
Dee Co., Wm. E.
Madison Foundry

Paints (Asphalt).
Barber Asphalt Paving Co.
Barrett Co., The
H. H. Robertson Co.
Truscon Steel Co.

Paving Blocks (Creosoted).
The Barrett Co.
Republic Creosoting Co.

Paving Brick.
Medal Paving Brick Co.
Metropolitan Paving Brick Co.
Murphysboro Paving Brick Co.
National Paving Brick Mfrs. Assn.
Springfield Paving Brick Co.

Paving Contractors.
Warren Bros. Co.

Paving Joint Compound.
Barber Asphalt Paving Co.
The Barrett Co.
Philip Carey Co., The.
H. H. Robertson Co.
Truscon Steel Co.

Paving Joint Filler.
Barber Asphalt Paving Co.
The Barrett Co.
H. H. Robertson Co.

Paving Machines.
F. C. Austin Co., Inc.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Warren Bros. Co.

Paving Plants (Asphalt).
F. C. Austin Co., Inc.
Barber Asphalt Paving Co.
Cummer & Son Co., The F. D.
East Iron & Machine Co.
Smith Co., T. L. The.
Koehring Machine Co.
Warren Bros. Co.

Pipe Dip and Coatings.
The Barrett Co.
H. H. Robertson Co.
The Texas Co.

Pipe Manufacturers.
American Cast Iron Pipe Co.
U. S. Cast Iron Pipe & Fdy. Co.

Pitch Filler.
The Barrett Co.
Warren Bros. Co.

Plows (Rooter and Wing).
Austin-Western Road Cach. Co.

Portable Paving Plants.
F. C. Austin Co., Inc.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Warren Bros. C o.

Portable Stone Bins.
Austin-Western Road Machinery Co.

Pumps.
De Laval Steam Turbine Co.
Smith Co., T. L., The.

Reinforcing For Pavements.
American Steel and Wire Co.
H. H. Robertson Co.
Truscon Steel Co.

Road Building Material.
Barber Asphalt Paving Co.
H. H. Robertson Co.
The Texas Co
Kentucky Rock Asphalt Co.

Road Binder.
Barber Asphalt Paving Co.
The Barrett Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Road Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Road Graders.
Austin-Western Road Machinery Co., The
Baker Mfg. Co.

Road Machinery.
F. C. Austin Co., Inc.
Austin-Western Road Machinery Co., The
Barber Asphalt Paving Co.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Mayer, F.
Warren Bros. Co.

Road Planer.
Austin-Western Road Machinery Co.

Road Oils and Preservatives.
Barber Asphalt Paving Co.
The Barrett Co.
Standard Oil Co. (Indiana)
The Texas Co.

Road Rollers.
Austin-Western Road Machinery Co., The
Barber Asphalt Paving Co.

Rock Crushers.
Austin-Western Road Machinery Co., The
Williams Patent Crusher & Pulverizer Co.

Rock and Sand Heaters.
East Iron & Machine Co., The

Roofing Material.
Barber Asphalt Paving Co.
The Barrett Co.
Philip Carey Co., The.
H. H. Robertson Co.
The Texas Co.
Warren Bros.

Sand Dryers.
Cummer & Son Co., The F. D.

Sandstone.
Cleveland Stone Co.
Ohio Quarries Co.

Scarifiers.
Austin-Western Road Machinery Co., The

Scrapers, Drag Line.
Pawling and Harnischfeger.
Sauerman Bros.

Scrapers, Graders, Plows, Etc.
Austin-Western Road Machinery Co.

Scrapers, Power.
Sauerman Bros.

Sewage Treatment.
Direct Oxidation Process Corp.
Electrolytic Sanitation Co.
Wallace & Tiernan Co., Inc.

Sewer Braces.
Kalamazoo Fdry. & Mach. Co.

Sewer Castings.
Dee Co., Wm. E.
Madison Foundry Co.

Sewer Cleaning Machinery.
Stewart, W. H.

Sewer Forms.
Heltzel Steel Form & Iron Co.

Sewer Pipe.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.
Vitrified Pipe Mfrs. Assn.

Sewer Rods.
Stewart, W. H.

Sidewalks (Stone).
Cleveland Stone Co.
Ohio Quarries Co.

Sluice Gates.
Coldwell-Wilcox Co.

Snow Removal Machinery.
Austin Co., Inc., F. C.

Special Castings.
Crane Co.
Flower Valve Mfg. Co.
U. S. Cast Iron Pipe & Fdy. Co.

Sprinklers.
F. C. Austin Co., Inc.
Austin-Western Road Machinery Co., The

Steel Joists, Studs and Sash.
Truscon Steel Co.

Steel Tapes.
Kolesch & Co.
Lufkin Rule Co., The

Stone Crushers.
Austin-Western Road Machinery Co.
Williams Patent Crusher & Pulverizer Co.

Stone Curbing.
Cleveland Stone Co.
Ohio Quarries Co.

Stone Elevators.
Austin-Western Road Machinery Co.

Stone Flagging.
Cleveland Stone Co.
Ohio Quarries Co.

Stone Spreaders.
Austin-Western Road Machinery Co.
Burch Plow Works Co.

Stone Screens.
Austin-Western Road Machinery Co.

Street Cleaning Machinery (Horse Drawn).
Austin-Western Road Machinery Co., The

Street Crossings.
Cleveland Stone Co.
Ohio Quarries Co.

Street Flushers (Horse Drawn).
Austin-Western Road Machinery Co.

Street Paving Material.
Barber Asphalt Paving Co.
The Texas Co.

Street Sprinklers (Horse Drawn).
Austin-Western Co., Ltd., The

Structural Steel.
Lewis-Hall Iron Works.
Minneapolis Steel and Machinery Co.

Surveyors' Instruments.
Kolesch & Co.
Lufkin Rule Co., The

Sweepers.
F. C. Austin Co., Inc.
Austin-Western Road Machinery Co., The
Elgin Sales Corp.

Tamping Machines.
Pawling and Harnischfeger.

Tanks, Water Supply.
Mensch, L. J.

Tar and Pitch.
The Barrett Co.
Philip Carey Co., The.

Tar Heaters.
Littleford Bros.

Tarvia.
The Barrett Co.

Testing Chemists.
Dow & Smith
Howard, J. W.
Kirschbraun, Lester
Van Trump, Isaac.

Traction Engines.
Austin-Western Road Machinery Co., The

Traction Engines (Oil or Kerosene).
Austin-Western Road Mach. Co.

Tractors.
F. C. Austin Co., Inc.

Trailers.
Warner Mfg. Co.

Trench Braces.
Kalamazoo Fdy. & Mach. Co.

Trench Machinery.
F. C. Austin Co., Inc.
Kalamazoo Fdy. & Machine Co.
Pawling and Harnischfeger

Trinidad Lake Asphalt.
Barber Asphalt Paving Co.

Turbines, Steam.
De Laval Steam Turbine Co.

Valves.
Coldwell-Wilcox Co.
Crane Co.
Flower Valve Mfg. Co.

Wall Coping.
Cannelton Sewer Pipe Co.

Warrenite.
Warren Bros. Co.

Water Pipe.
American Cast Iron Pipe Co.
Cast Iron Pipe Publicity Bureau

Waterproofing.
Barber Asphalt Paving Co.
Barrett Co., The
H. H. Robertson Co.
The Texas Co.
Truscon Steel Co.

Water Purification.
Direct Oxidation Process Corp.
Electric Ozone Sterilizer Co. of America.
Electrolytic Sanitation Co.
Pennsylvania Salt Mfg. Co.
Wallace & Tiernan Co., Inc.

Water Works Supplies and Equipment.
American Cast Iron Pipe Co.
Alger Supply Co.
Cast Iron Pipe Publicity Bureau
Coldwell-Wilcox Co.
Crane Co.
Flower Valve Mfg. Co.
Pennsylvania Salt Mfg. Co.

Wheeled Scrapers.
Austin-Western Road Machinery Co.

Wire Rope.
American Steel & Wire Company

Windows (Steel).
Truscon Steel Co.

Wire-Cut Lug Brick.
Medal Paving Brick Co.
Metropolitan Paving Brick Co.
Murphysboro Paving Brick Co.
Springfield Paving Brick Co.

Wood Block (Creosoted).
Barrett Co., The
Republic Creosoting Co.

Wood Preservatives.
Barrett Co., The
Republic Creosoting Co.

MOTOR TRUCKS

Motor Trucks as Operated in Municipal and County Service and in Highway Transportation

BOTH
THIS NEW 120-INCH WHEELBASE, HEAVY DUTY AUTOCAR, AND THE 97- AND 120-INCH WHEELBASE 1½-2 TON AUTOCARS WILL BE EXHIBITED:

Chicago Truck Show
January 24 to 31
International Amphitheatre

Announcing an Addition to the Autocar Line

This new heavy duty motor truck has behind it the prestige, the resources and the unusual service organization of The Autocar Company.

The short wheelbase design and double reduction gear drive, distinctive of all Autocar construction, are embodied in this heavier Autocar.

The Autocar Company

Established 1897

Ardmore, Pa.

The Autocar Sales and Service Company

New York	Boston	Philadelphia	Chicago	Pittsburgh
Brooklyn	Providence	San Francisco	Allentown	St. Louis
Bronx	Sacramento	Los Angeles	Worcester	Baltimore
Wilmington	New Haven	Washington	San Diego	Fresno
Newark	Oakland	Stockton	Atlantic City	

Autocar

Printed as insert to MUNICIPAL AND COUNTY ENGINEERING, January, 1920.

Motor Truck Operation and Accounting LIII

More interesting data on the performance of motor trucks in highway construction work came to us from New Mexico, a state in which specific information on this subject is systematically compiled. Mr. C. B. Sampson, District Engineer of the New Mexico State Highway Commission, in charge of five counties and with headquarters at Las Cruces, writes:

"From my observation in the hauling of materials for highway construction and from comparative costs, I find that horse drawn vehicles, where the maximum haul exceeds three miles, are not as economical as trucks and trailers, the truck and trailer having a slight advantage over the truck alone. The hauling of materials by tractor up to date has not proved economical in this district. This, however, I am inclined to think, is because the condition of the roads over which this tractor and wagon train hauled gravel was such as to cause many break-downs. The repair account and lost time account was unusually heavy.

"For hauls of two miles and not exceeding three miles,

Tractor No. ____ Auto No. ____

Truck No. 21 **SEMI-MONTHLY REPORT**

Make Nash Quad Capacity 2 Tons Period Nov 1-16-19

No. miles surfaced 1017-9x44	Totals		Labor Used
No. miles empty 320	133 Gals. gas 30	$39.90	Laborers $45.98
No. miles loaded 259	15 Gals. motor oil	$ 3.90	Driver $56.00
No. miles dragging	6 Lbs. transmission grease	$ 1.20	Foreman $
No. miles plowing	1 Lbs. grease cup	$ .40	
No. miles grading	Repairs	$ 6.35	
No. miles traveled 579	Other expenditures	$	
No. miles trimmed	Total cost	$	Total labor $101.98
Other work	Total cost operations		$

Gravel hauled 113 cu. yds.
Crush stone hauled ____ cu. yds.
Material hauled 169 tons
Supplies hauled ____ tons
Total tons miles 676

Remarks

(over)

FIG. 1—FRONT SIDE OF SEMI-MONTHLY REPORT CARD FOR ALL MOTOR TRUCKS OPERATED BY THE NEW MEXICO STATE HIGHWAY DEPARTMENT.

the truck cost and the horse-drawn vehicle cost are nearly equal. For hauls less than two miles, the horse-drawn vehicles prove to be more economical than trucks.

"All of this information is based upon the trucks and wagons being loaded from a bin. Where they are loaded by hand, the horse-drawn vehicles have a decided advantage, due principally to the fact that the valuation or depreciation charge is not as great when the wagon or truck is standing still.

"Our costs per *yard-mile* are as follows:

Horse drawn vehicles....35 to 40 cents per yard;
Trucks.....30 to 35 cents per yard;
Trucks and trailers .....25 to 30 cents per yard.

A. E. St. Morris, District Engineer of the New Mexico State Highway Commission, in charge of four counties and with headquarters at Los Lunas, contributes the following data:

"Work 1916-1917—Teams hauled gravel at rate of 25c per yard mile. This cost covered the hauling only; loading was extra. Two teams keep 8 and 10 wagons going all day, one man and foreman. Teams were paid $2.50 per day, Foreman $3 per day, Labor $1.50 per day.

"1919—Teams Force account cost $1.00 per yard mile including loading charges, at this time wages had advanced. Teams $4, Labor $2, Foreman $3.50. Hauling gravel, the above.

"1919—White five ton truck; power-dump. Contract price 25c per yard mile. We loaded the truck and kept it going in preference to one owned by the County.

"Teams loading at $4, Labor $2. Foreman was driver on County Truck and was paid $3.50. The contractor after 6 weeks' work asked for increase and I then paid him 30c per yard mile as I could not see where he made any money hauling at the figure of 25c.

"1919. We have been using trucks that have been turned over to the State by the Federal Government and are getting very good results. They are costing us on an average of 44c per yard-mile including depreciation and rental.

"A card report is kept up semi-monthly on all trucks operated by the State Highway Department."

The two sides of the report card mentioned by Mr. St. Morris are shown in the accompanying cuts.

Total cost operating truck	$152.73
Depreciation or rental	$ 41.00
Total this month	$193.73
Cost per mile this month	32+
Cost per mile to date	34+
Cost per ton mile this month	28+
Cost per ton mile to date	37+
Total miles this month	579
Total miles to date	1609
Total ton miles this month	676
Total ton miles to date	1493
Total cost operations to date	561.21

A. E. St. Morris
District Engineer.

—REVERSE SIDE OF CARD SHOWN IN FIG. 1.

Wilson

DEPENDABLE MOTOR TRUCKS

ARE ADVERTISED BY THEIR OWNERS

NOTICE TO TAXPAYERS

"The undersigned makes this statement for the benefit of the taxpayers of Warren county. There has been a great objection and kick on the use of the truck on maintaining and keeping up our county roads. I have driven a Wilson truck one hundred and three days in the county and worked in every township in the county but one, and in that time I hauled 1,030 yards of gravel an average distance of 5½ miles. I pulled a road drag 198 miles and the road grader 128 miles. I have kept an account as correctly as possible, and in my judgment, it will cost $7 per day to operate a truck, not counting anything for repairs, and in the 103 days we spent 50 cents for a fan belt, $2 for two spark plugs, total $2.50. As this objection is found all over the county, some found fault with the commissioners and some found fault with the road superintendent and some did not know who to blame. A great many ask if I thought it paid. Well, boys, a truck properly handled and put the push in it will do the work of from 5 to 9 teams, and to bear this statement out, will refer the doubters to the men I worked for, Lewis Noles, of Pine Village, Harvey McElhoe, of Williamsport, Chas. Renville, of Pence, Chas. Hickman, of Tab, Norma Bartlett, of Rainsville. The sub-superintendents of the county think that my statement will enable the taxpayers to figure out for himself as to whether the truck pays. The county needs one truck in each commission district is my judgment in the matter of trucks."

(Name on request.)

This clipping appeared in a local newspaper recently and affords food for thought. We consider it one of the most striking endorsements for ***Wilson Motor Trucks*** ever written. Name of paper and road commission on request.

J. C. WILSON COMPANY

DETROIT, U. S. A.

Performance of an Acme Truck in Garbage Collection in Lethbridge, Alberta

The following paragraphs were written by H. Wm. Meech, Commissioner of Public Works, Lethbridge, Alberta, Canada:

Lethbridge, Alberta, is a city of about 13,000 inhabitants in the southern part of the Province of Alberta about 48 miles north of the International Boundary.

The city is the center of a large irrigated as well as dry farming area and is itself built on a bed of coal. Several large mines are being operated practically adjoining the city limits. The city, therefore, consists of those whose business it is to deal with the farm trade, a considerable number of miners, some small but healthy manufacturing establishments and a tairly large wholesale and warehouse section, the city being the distributing center for a tremendous farming and coal mining area.

The city has a liberal allowance of parks and is situated on the banks of the Old Man River where it curves fairly rapidly, and like most new cities is not very thickly built up and for these reasons is scattered over a large area. This means very long hauls for a city of this size, some portions of the outlying residential districts being a matter of three miles from the dump.

The garbage is dumped over a steep cliff on the extreme west end of the city and is kept continually burning. Until early in 1918 the collection outfit consisted of five single horse dump carts and with the long hauls already referred to it can be readily understood that the slowness of the horse drawn carts was not conducive to efficiency and resulted in numerous complaints as to service.

Early in 1918 the question was seriously tackled by the Commissioners and the result of their deliberations was that an Acme 2-ton truck was purchased. This was purchased from the Brehm-McMullen Co. of Minneapolis and is fitted with Continental Motor, Cotta Transmission, etc., and has a hydraulic lift for dumping. This was an excellent move and showed good judgment but it soon developed that while the truck was a very fine one, it was not going to bring the desired results without scientific handling of the collection system.

The writer then went carefully into the question of getting the most possible out of the truck and it was evident that while it was not capable of taking the place of the complete old outfit of five horses and carts, it could take the place of four.

The object in view was to give the compact business district a daily collection service, some smaller outlying stores and apartment houses a service every second day and the whole of the residential districts a weekly service. This was a better service than had ever been attempted before.

They were obviously most economical for long hauls and fortunately the business district was fairly near the rubbish dump. A single horse and cart was therefore put on the short hauls to give the business district a daily service and all the longer hauls were given over to the truck. Outside the horse area, the city is divided into six districts and each district is covered daily by the truck, and the day's work is so arranged that where more than a daily collection is necessary in the truck district, the truck takes care of it.

It has been fully demonstrated that a reliable Auto Truck collection system is far more economical than horse drawn vehicles, but the importance of systematic routing cannot be over-estimated and is a vital factor. This is particularly true of long hauls.

Following is a comparison of cost of two periods, the first before the truck was operated and the second showing a year's truck service.

	Wages	Stables	Supplies	Office Supt.	Total
June, 1917, to June, 1918	3,085.49	8,782.28	492.38	511.00	12,870.15
July, 1918, to June, 1919	4,960.82	3,975.59	1,314.62	365.00	10,616.03

* In comparing these figures, it should be remembered that wages have been increasing over the entire period and the item, wages, for the first period if the old system had been retained would have amounted to $4,926.68. Also the item, stables, would be changed by the increased price of horse feed, etc., and the total cost if the old horse system had been retained, would have amounted to $14,051.64 or a comparative total difference and saving in cost of $7,121.65 instead of $2,254.12.

The cost per load for the month of August, 1919, for auto truck and car is as follows:

	Cost per Mi.	593 Mi.	Cost per Load (121 Loads)	Cost per Hr. (206 Hrs.)
Gas	56.38	.0950c	.4660c	.2730c
Oil	11.65	.0195	.0960	.0565
Repairs	16.35	.0275	.1350	.0800
Driver and help	425.35	.7170	3.5150	2.0650
Total	509.63	.8590c	4.2120c	2.4745c

Horse and Cart	Cost per Load (213 Loads)	
Total Cost	$205.60	96.5c

The area covered by auto truck is about six square miles and the area covered by the horse and cart is about one half a square mile.

The average weight per load by the truck is 3,150 lbs.

All residents are requested to put their garbage into cans or other receptacles that can be lifted, and co-operation on the part of the citizens is necessary and this has been accorded the authorities here. Two men travel with the truck in addition to the driver for lifting the garbage.

To sum up; if we had carried on the old horse and cart service the difference in cost for one year would have been more than the cost of the truck and we are giving a better service by the truck than was possible by the old system, and we have eliminated all complaints.

Big Features of the New Gramm-Bernstein Line.

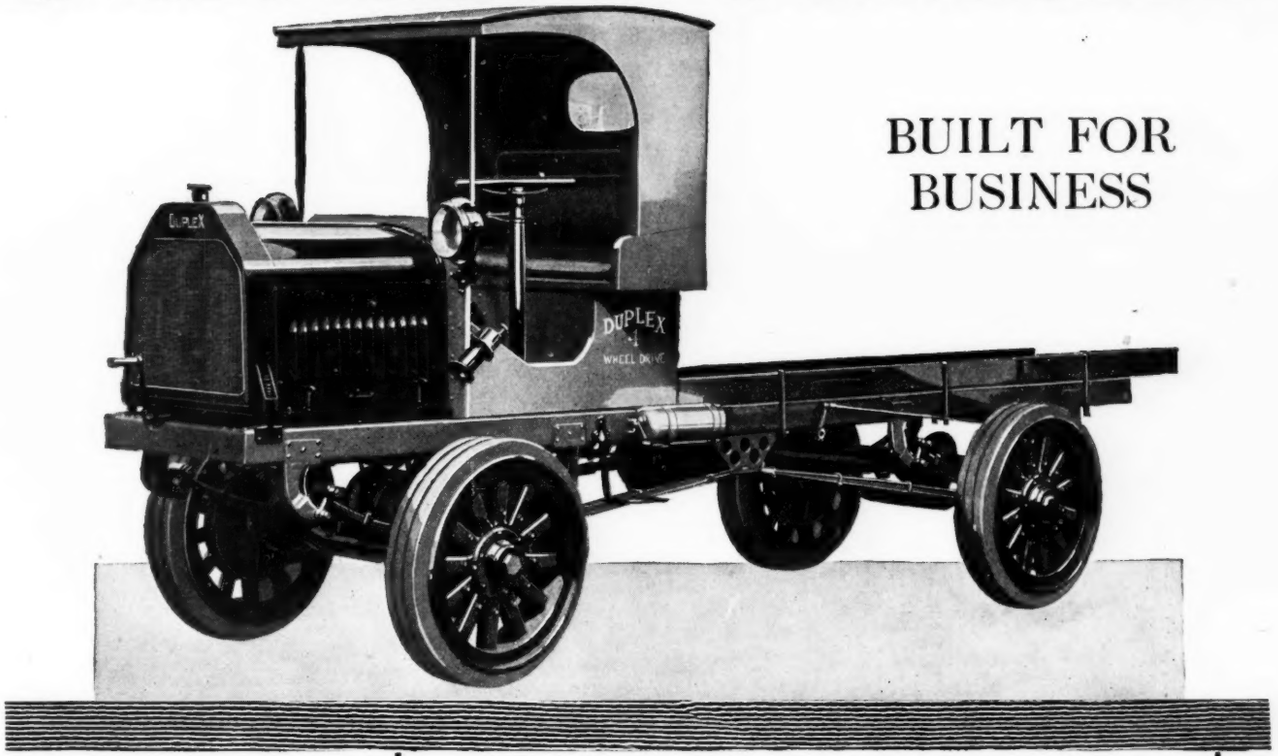
An accompanying illustration shows the new Gramm-Bernstein 5-ton dump truck, 1920 model, which is greatly improved and carries as regular equipment many valuable features which have hitherto been sold as extras by most manufacturers.

Included in the chassis price are a standard cab with doors, storm curtains and ventilating windshield, electric lights and horn, motometer, radiator guard, radiator shutter, army towing hooks, steel wheels, fenders and steps, license plate brackets, spring trailer draw-bar, etc.

The body illustrated is a square corner steel dump, operated by hydraulic hoist and B. A. Gramm's patent power takeoff device. The Gramm-Bernstein Motor Truck Company claim that this is a basic patent covering all means of taking power from a truck for any purpose other than the propulsion of the vehicle itself.

The new Gramm-Bernstein line in addition to the policy of complete equipment is driven in the 2½, 3½ and 5-ton capacities by a Liberty Truck type motor with de-

DUPLEX TRUCKS



BUILT FOR BUSINESS

The Duplex Limited

HERE is a general purpose truck of medium capacity, pneumatic tired, which develops a road speed of 25 miles per hour *loaded* with the motor running only 1300 R. P. M.

This means that the *power is in the motor itself*—and that the Duplex Limited does not depend for its power on low gear ratio.

The Duplex Limited is a Duplex through and through—fully as fit for its class of work as the famous 4-Wheel Drive—which has such a wonderful prestige in the heavy duty field.

4 Cylinder, enclosed type motor—water cooled—cast enbloc. Bore 4", Stroke 5¼". 4 Point Suspension. Pneumatic Cord tires. 145" wheel base. Equipped with Windshield, Electric lighting and starting; Ammeter; Boyce Motometer; Speedometer; Electric Horn; Tools; Jack; Rim Wrench; Front fenders; Alemite Grease gun. Driver's seat without extra charge. (Power Tire Pump at extra charge.)

Write for Booklets Describing the Duplex Limited.

Duplex Limited
$2575
f. o. b. Lansing

IT is a fact that greater numbers of trucks are today being bought on their known performance value—not what you think they can do but what they actually do accomplish.

The famous Duplex 4-Wheel Drive Heavy Duty Truck has back of it years of remarkable achievement—and a standing so high that it is generally accepted as the leading truck of its kind.

In the Lumber and Logging Industry; in the Oil Fields; in Road Construction work; for hauling Sand, Gravel and Concrete—in fact wherever *heavy hauling* is done there you will find Duplex 4-Wheel Drive Trucks—and you will find them making good.

The Duplex Truck Company is one of the oldest and most successful truck companies in America—made so by the *owner service* of the Duplex Truck itself.

Today Duplex 4-Wheel Drive Trucks are finding increasing favor in all lines of business because everywhere business men want to get away from experimenting with trucks.

The facts about the Duplex 4-Wheel Drive are becoming more and more known.

Duplex 4-Wheel Drive—3½ Ton Capacity. Price $4250, f. o. b. Lansing.

The more critical you are as a buyer the more essential it is that you investigate the Duplex. Write for folders which give the facts about the Duplex in owners hands.

DUPLEX
BUILT
FOR BUSINESS

Duplex Truck Company
Lansing · Michigan

One of the Oldest and Most Successful Truck Companies in America

tachable cylinder heads and hot spot manifold, also heavy truck type battery and vacuum feed system.

All worm drive models are equipped with the Gramm-Bernstein standard "constant mesh" transmission which the manufacturers claim is a great improvement over the sliding gear transmission for trucks and give as proof the statement that an accurate record of all transmission repairs for all Gramm-Bernstein trucks in service over a period of one year showed an average of 32c per truck.

One of the big features of the new Gramm-Bernstein line which will be appreciated during the winter season is the addition of a Boyce Motometer and radiator shutters as regular equipment. With the shutters closed the engine is kept warm and with the aid of the motometer the driver can keep the temperature of his engine at the proper point to insure the utmost economy in operation and gasoline consumption.

The new Gramm-Bernstein line possesses a decidedly husky appearance which the manufacturers claim is not belied by the actual performance of the truck.

Truck Owner Makes New Transportation Record

What is believed to be a new record in motor truck efficiency, considering distance traveled, time taken and size of load, according to information received by the International Motor Co., of New York, was recently made by Lee B. Hawkins, of Moneta, Cal., who operates a fleet of 8 Mack trucks.

A seed firm near Los Angeles wanted to ship 15 tons of seed in a particular rush to another town 225 miles away. No freight car was available, so they asked Hawkins if he could make the delivery in two days. He took the consignment, and with two of his Macks, one carrying 10 tons and the other 5, started out for the town of Calexico the next morning. At night a stop was made and the trip resumed at dawn. Calexico was reached in 30 hours after the start.

Arrangements were then made to receive a return load of nearly 15 tons of dried milk at El Centro, 10 miles from Calexico. This was delivered at San Diego, a distance of 100 miles. There 15 tons of fish were loaded on and delivered in Los Angeles, 130 miles more.

Reaching home at Moneta at midnight, one of the trucks hooked onto a trailer and the truck and trailer delivered 17½ tons of tomatoes by next morning to a cannery 25 miles away. At a town nearby, 7½ tons of well casing were taken on and delivered that night at Elsinore, 100 miles away over the mountains.

Compare this performance with what would have been done by railroad transportation. No more remarkable example of motor truck efficiency could be asked for. There have been many instances of unusual performances of trucks that have been staged as stunts by dealers or manufacturers, but this is a case where the owner capitalized on the proved utility of his trucks. It shows what any other owner can do if he solicits return loads in a persistent manner.

The Motor Truck a Serious Competitor of the Electric Railway

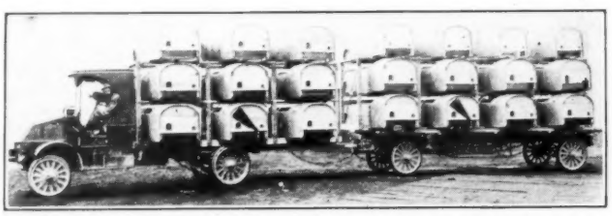
"That the motor truck is a serious competitor of the electric railway in dependable and economical haulage of freight and merchandise," says H. P. Branstetter, Chicago Kissel distributor, "was again evidenced recently, when I understand the Milwaukee Northern Electric Co. applied to the railroad commissioners at Madison, Wisconsin, for authority to increase its fast express rates by zone, so that it may compete with the motor trucks running between Milwaukee and Port Washington.

"I understand that the highways between these two points are excellent examples of good roads, which if a fact, is one explanation why motor trucks plying over them are able to compete with the railroads in low rates as well as in time schedules.

"This is only another example of the benefits of good roads. If the motor truck is given a square deal, and by a square deal I mean a right of way of good roads, a driver that knows how to handle his truck, a truck that is built of quality materials on the right principles and loaded the way it should be loaded, both as to capacity and division of weight over the entire truck, you will find that the motor truck is the most economical, dependable and adaptable transportation unit in the country today."

Kelly Truck and Troy Trailer in Intercity Haulage

A truck and trailer outfit owned and operated by the J. S. Wagner Transfer & Storage Co., of Springfield, Ohio. This concern is a general trucking concern, and the overland transportation coming into its own as it has, these people saw the advantage, and purchased a Troy 3-ton trailer with a 22-ft. chassis, which they use in connection with their truck, which has a body equipped with special racks.



KELLY TRUCK AND TROY TRAILER HAULING 21 TOURING CAR BODIES FROM MUNCIE, IND., TO SPRINGFIELD, OHIO, A DISTANCE OF 100 MILES.

As the Wescott Motor Co., of the same city had considerable trouble in getting freight, in fact were tied up for the want of cars, and when they could get a car, it would take them just one week to get a carload of bodies from Muncie, Ind., to Springfield, Ohio, the above company got on the job. The accompanying photograph shows this outfit loaded with 21 of the light Six touring car bodies, which is equal to the number that can possibly be loaded in a 40-ft. railroad car. These bodies were transported from Muncie, Ind., from the Wescott Body Factory there, a distance of approximately 100 miles each way. The round trip is made with truck and trailer in 20 hours, and this includes the loading and unloading time. The average mileage per hour on the road is about 15. Under normal conditions it would require by rail, one week to get the bodies, which they get by overland transportation in 20 hours.

The Westcott Company's traffic manager states to ship the bodies by truck and trailer is a little more expensive than by the railroads, but owing to the delay which the railroads would cause them, they are getting off a great deal cheaper by using truck and trailer, from the fact they are not held up on deliveries. In bad weather these loads are covered with a large canvas envelope which fits closely over the bodies on both the truck and trailer.

Ready for the Body; Not an Extra to Buy

Gramm-Bernstein savings begin even before the truck is put to work. They actually begin with the very purchase of the chassis.

For it is sold completely equipped and ready for the body.

There is literally not an extra to buy.

Gramm-Bernstein Trucks carry, as standardized equipment, $500 to $550 worth of accessories, according to type and size.

This equipment is all essential to truck operation. Any truck must have it.

Ordinarily, it is paid for, over and above the chassis price.

Nothing of the sort with Gramm-Bernstein. It is complete and ready for the body needed in the work it is to do.

In this, as in the industry itself, and in most of its forward steps, B. A. Gramm has led the way.

Gramm-Bernstein Trucks today have behind them something even greater than almost 20 years of truck building and inventive experience.

They have an honorable record of performance and economy—of high duty and low cost.

They are so firmly entrenched that Gramm-Bernstein owners invariably add a Gramm-Bernstein when they need another truck.

Gramm-Bernstein reliability, willingness to work, and extraordinary long life, are almost proverbial among business men who have experienced them.

Any comparison of work done, on a cost-mile basis of operation and maintenance, will demonstrate the greater economy of Gramm-Bernstein.

Any comparison of truck experience, truck units and truck equipment will demonstrate the greater value of Gramm-Bernstein.

Any Gramm-Bernstein dealer will be glad to advise with you.

All Gramm-Bernstein Transmissions are provided with a pad for attaching Gramm's Basic Patent Power Take-off. Dealers and truck owners should assure themselves that any trucks purchased with power take-off do not infringe B.A. Gramm's Basic Patent No. 1194994.

"Extras" are Standard on G-B Worm Drive Chasses

Standard Gramm-Bernstein cab, with doors and storm curtains.

Exceptionally rugged metal ventilating windshield.

Front fenders and steps.

Sturdy radiator guard, attached to frame independent of radiator.

Radiator shutter, operated from seat—facilitates starting, saves gasoline.

Boyce motometer, to indicate temperature of engine.

Army truck type towing hooks at front end. Spring trailer drawbar at rear, on larger types.

Electric generator. Side lights with dimmers and non-glare lenses; dash light; bullseye tail light, protected in frame; electric horn.

Patented Gramm-Bernstein always-in-mesh transmission, with outside filler spout.

Patented wick oilers on all spring bolts.

Metal license brackets, front and rear.

100,000-mile hub odometer.

GRAMM PIONEER BERNSTEIN

The Gramm-Bernstein Motor Truck Co., Lima, Ohio

Pioneers since 1901—Builders of the First Liberty (U.S.A.) Truck

New York National Truck Show: Jan. 3-10. Section P, Space 6, 7, 8—8th Coast Artillery Armory
Chicago National Truck Show: Jan. 24-31. Section C-4, South Wing—International Amphitheatre

3½ Ton Worm Drive Gramm-Bernstein

Ship by Truck

GRAMM-BERNSTEIN

The weight of the bodies will average about 500 lbs. each, making a total load of only 10,500 lbs. for both truck and trailer. In this particular case, it is not the weight of the load that counts, as in many other cases the load bulks considerably and there is still no weight of any consequence.

Scale in Truck Engines

A recent bulletin sent out to the distributors of Service Motor Trucks, over the signature of Charles Guernsey, Chief Engineer, has quite a universal application and is well worth the attention of truck users. The notice is as follows:

"Our attention has been called to the fact that in some territories heating of engines has been caused by accumulation of lime, iron, or other impurities in the water jackets of the engines. These impurities stick to the outside of the cylinder walls just the same as scale sticks to a boiler. This scale on the cylinder acts as an insulating wall and results in overheated engines.

"In order to remove this scale it is recommended that the cooling system be drained and thoroughly flushed with water, then the lower pump connection plugged up and the water jacket (not the radiator) filled with a solution made of one part of hydrochloric (muriatic) acid of a specific gravity of 1.20 and three parts of water, by volume. This solution may be left in the water jackets until the scale has become loosened, and in fact the solution may be made a little stronger at the last.

"After the scale is loosened, the water jacket should be flushed with pure water, by means of a hose, for several minutes. It is necessary that the acid be thoroughly removed after cleaning to avoid permanent action on the cylinder walls.

"This solution should not be used in the radiators, as it will attack any impurities present in the copper."

What's In a Rating?

"It doesn't take a long memory to recollect the days when the advertised horsepower of a vehicle was largely taken into consideration by the inexperienced buyer in comparing automobiles," says Mr. H. T. Thomas, Vice President and Chief Engineer of the Reo Motor Car Company. "He might have narrowed his choice down to two cars that looked alike to him and sold for about the same price. But one was rated by the manufacturer as having a motor of 60 horsepower and the other claimed only 35. So he bought the first, only to find, perhaps, that a friend who bought the other make could pull past him in any sort of tough going.

"For a time the advantage seemed to be with the tallest claimer for there was a new crop of first-car buyers each spring. But the thing couldn't go on forever. The S. A. E. established a basis which, while it might not be accurate for all types of motor, was at least definite.

"The question of capacity rating for motor trucks is in much the state that horse-power rating of passenger motors was ten years ago. In consequence a maker's tonnage rating indicates next to nothing.

"There is no standard basis for the rating of trucks. Each maker now fixes his own rating and the rating depends in part on his modesty, or tendency to exaggerate. It depends in part on the conditions of use he has in mind when he rates it, and further on his own knowledge of his own vehicle.

"Take Reo for instance. Away back six years ago when we designed the Speedwagon it was a pioneer vehicle. It had pneumatic tires, electric lighting and starting, and passenger car speed—things unheard of in a truck. It was natural that we should then have rated this job conservatively.

"The Speedwagon passed out into the hands of Reo users and little by little they began to pile more and more upon it. Now we are frank to admit that 30,000 Reo owners through the years of use have proved that the Speedwagon is a stronger truck than we cared to claim for it in the beginning.

"No motor truck can be given a blanket rating which will be accurate under all conditions. So much depends on conditions of road, of load and of use. A great deal depends on a driver. We cannot say whether our truck would have a capacity of 1,500 lbs. or 3,000 without knowing the conditions of use.

"Some users prefer to haul large overloads on their Speedwagon and figure on buying a new one frequently, rather than using slower, more costly, vehicles. Others keep near the ton mark, give the truck the utmost care, and have a five year expectancy. And other Speedwagon users usually have loads of less than a ton, but pile on more in the emergency, and find that with careful driving the truck comes through without harm.

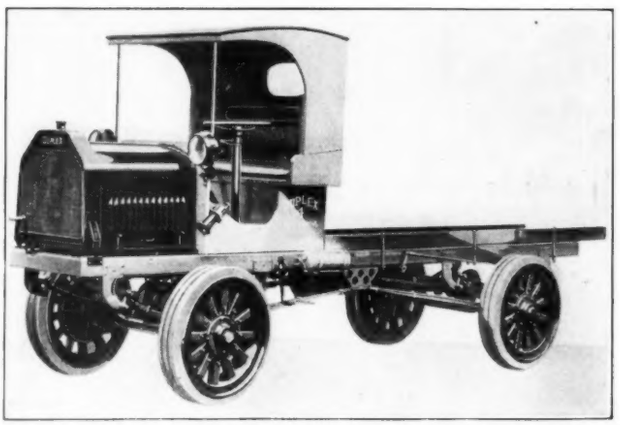
"All of which does not even touch the problem of whether it's better to do the work by making two trips with a light, fast truck while a bigger truck would be making one."

Good Roads and Trucks

Probably the announcement that the proposed expenditures in the United States for 1920 for hard-surfaced highways will be $633,000,000 as compared with $125,000,000 expenditures of 1919 for the same purpose should mean more to the farmers of this country than nearly any other class.

It is a significant fact that nearly 60 per cent. of the trucks of the United States work in the country, though a large percentage of them may be housed in the city. Though about 20 per cent. of them are actually owned by farmers, which represents 10,000 more than are used by any other class of produers, the manufacturers who come next in line in the use of trucks.

"A simple study of these figures will bring home to the residents of the rural communities," declares M. L. Pulcher, vice president and general manager of the Federal Motor Truck Co., Detroit, Mich., "the tremendous



THE DUPLEX 4-WHEEL DRIVE, MUCH USED IN HEAVY-DUTY FIELDS.

advantage that will accrue to them through the large appropriation for new roads the next year.

"Thirty per cent. of the people from whom 60 per cent. of the trucks of this country work will certainly receive their share of new highways. It means that their 60 per cent. of the trucks will have just that many more and better road facilities for the transportation of the goods they are accustomed to transport.

"But it means even more than that. It means that more roadways, the forerunner of the truck and civilization, will enable them to use the trucks for transporting an even greater variety of commodities with a consequent saving of money and time.

"The possibilities of the truck for carrying commodities between farms and cities have only been touched. The newer and better roads will give the impetus needed to bring out all its possibilities."

Packard Schools Teach Drivers Care of Trucks

The cost of truck transportation can be greatly reduced by teaching drivers and owners how to drive and maintain their truck equipment. This fact has been proved by the Packard schools for instruction in truck operation. These schools, which are conducted by Packard distributers throughout the country, have turned out several thousand graduates, with the result that both the men and their trucks have given more efficient service.

There are no enrollment fees for the instruction course, the hours are arranged so as not to interfere with the work of the chauffeurs, and there are no tiresome lessons or studies to prepare. The work consists in a series of informal conferences, and is practical rather than technical. No attempt is made to turn out expert mechanics or repair men, but effort is concentrated on making good drivers who can prevent trouble rather than cure it. Special stress is laid on making the minor adjustments that keep the truck in best running form, on detecting and correcting little troubles before they become big.

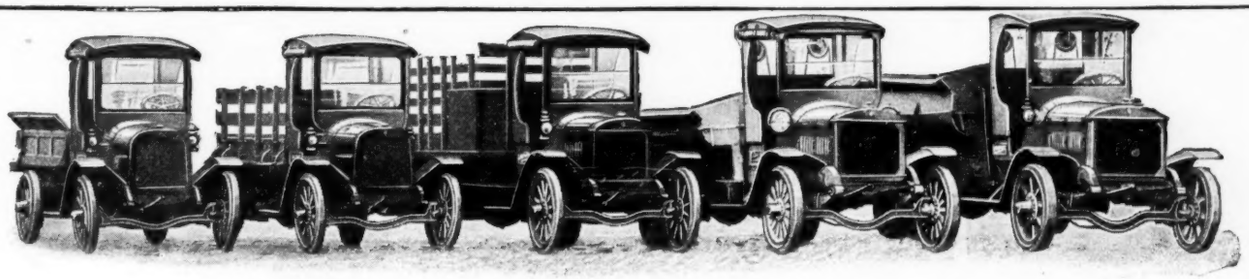
After the first lecture in which the truck structure and operation is made clear in a general way, subsequent sessions take up specifically such details as the gasoline system, cooling and lubricating systems, electrical system, clutch and transmission, steering, brakes and controls, loading and similar matters, the whole course covering from six to ten sessions. Where required the course is supplemented by actual driving periods for demonstration.

Among the cities in which schools are now conducted by Packard Distributers, are New York, Boston, Philadelphia, Chicago, Kansas City, St. Louis, Cleveland, Indianapolis, Baltimore, Albany, Omaha, Scranton, Milwaukee and Detroit. Some of the Packard Distributers, in addition to the truck instruction, conduct a separate course for owners and drivers of passenger motor cars.

The certificates issued by the schools to those who complete the course, are recognized as a guarantee of a driver's ability by any Packard Branch, and the certificates in Detroit are accepted by the city authorities as evidence of the holder's competency as a truck operator.

Putting Operating Costs on a Systematic Basis

At last to do away with cut-throat competition and to put operating costs on a systematic basis of computation have come the truck transportation associations in our largest cities. The average small truck cartage man



Complete line of Acme Trucks as displayed at the National Automobile Shows.

Where Proved Construction is of First Importance

You can have definite assurance of the highest type of motor truck service. For Acme proved construction and Acme Proved Units are tangible qualities that you can count on even in the face of hard and heavy work that trucks in engineering and contracting service are expected to do.

21 Per Cent of all the Acmes built go into Construction Service.

In every phase of engineering and contracting you'll find Acme the preference, for Acme by construction is typically fitted for this field. Made by a modern truck building organization, with wood-body and steel-body building plants, Acme can deliver trucks complete, ready for service on any size job.

Built in 1, 1½, 2, 3½ and 5 Ton Models.

Acme proved construction means that you get proved performance in units which the engineers of the industry regard as leaders, all carefully selected and assembled by Acme engineers in a well-balanced truck. Write for catalog and partial list of users in the engineering and contracting fields. Address Department 187.

ACME MOTOR TRUCK COMPANY, Cadillac, Mich.

ACME THE TRUCK OF PROVED UNITS

The Seal of Dependable Service *Trade Mark Reg. in U. S. and Foreign Countries*

has not always been a good business man. Repairs, insurance, depreciation and operating costs have not always been figured out intelligently, many of the items not at all, with the result that many times profits on a fairly considerable investment have been almost negligible.

"The advantages of such associations cannot be overestimated," declares M. L. Pulcher, vice president and general manager of the Federal Motor Truck Company, Detroit, Mich. "Detroit, Chicago, Cleveland and New York have such associations and Pittsburgh cartage men have just organized one.

"The organization in Detroit found that there is business for all on a profitable basis through co-operation. They are solving the return load problem through reciprocity and the operation of a return load bureau; doing co-operative buying; studying operating costs; giving free information service; waging war on price cutters; conducting a clearing house for motor truck interests.

MACK MOTOR STREET SPRINKLER IN SERVICE OF CITY OF WOONSOCKET, RHODE ISLAND.

"The mutual exchange of business is the most important feature of their co-operation. A member who has more business than he can handle for the day, sends down to the bureau the name of the person who desires service and the capacity of the truck desired for the service.

"The idle truck owners for the day are listed. They are given the opportunity to take the work in the order in which they are listed. There is no charge. Thus is eliminated the idle hour.

"Night schools are also conducted by the association. In these organizations we have the possible solution of ruthless competition. It is constructive co-operation, the experience and knowledge of trucking all possess becoming the common knowledge of each."

THE NEW DUPLEX LIMITED

Convinced in their own minds and supported by insistent requests of dealers and users alike, the Duplex Truck Co., Lansing, Michigan, after three years of careful and far-reaching investigation determined to meet the great need in the truck field for a medium capacity continuous service model, capable of running at high rates of speed.

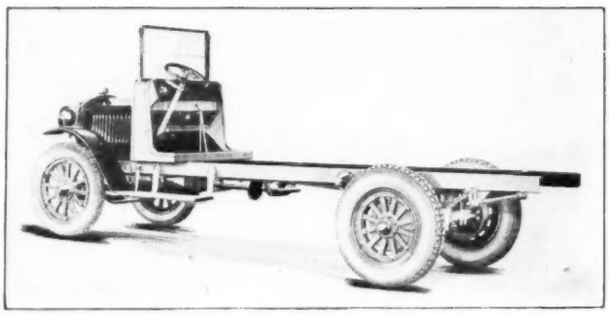
Heretofore numerous attempts have been made to adapt models designed for other purposes to quick delivery uses but these have proven very unsatisfactory. Their failure has been due to the fact that a construction intended for slow, heavy hauling will not stand up under the extra strains imposed by fast driving.

To serve this class of truck user properly the Duplex Co. set about to design and build such a model. The result is what is known as the new medium capacity pneumatic equipped Duplex Limited. Only specifications that contribute to speed and extra strength to stand such speed have been selected.

Power is supplied through a 4 x 5¼-in. motor having an S. A. E. rating of 25.6 horsepower. This motor is a modified class "B" design so successfully used in government work. At normal speeds the motor develops more power than its rating would indicate and its construction permits of high speeds without danger of injury. On high the Duplex Limited will travel at from 5 to 30 miles per hour.

The Duplex Co. contends that truck speeds should be secured through motor power and not through a low gear ratio. This accounts for the adoption of a motor which at first glance, appears to be too large for a truck of medium capacity.

All the essentials necessary in truck design to guarantee speed, safety and economy are found in the new Duplex Limited—surplus motor power-pneumatic tires—a high gear ratio. Everything that will contribute to making this a strictly high class, steady service truck has been included by the manufacturers. Electric lighting and starting equipment is a part of the Duplex Limited.



THE NEW DUPLEX LIMITED, MEDIUM CAPACITY, 2-WHEEL DRIVE.

The Duplex factory reports that even their own expectations have been surpassed with regard to the way an apparently flooded market has already responded to the news regarding this addition to their line.

ECONOMICS OF MOTOR HIGHWAY TRANSPORTATION

By R. C. Spinning, Advertising Manager, Service Motor Truck Co., Wabash, Ind.

During the war much propaganda appeared, urging people to use the highways for transportation during the break-down of our railroad system. The highways were used, at first as a wartime measure, but later, after their efficiency had been amply demonstrated, as a general means for communication.

Everyone admits that motor trucks and motor truck efficiency were big factors in the winning of the war. It is only natural, therefore, that we should call upon the truck to help solve the problems of complex commercial transportation.

Expansion Depends on Motor Trucks

The commercial expansion of this country and the

Increase Your Sources of Supply and Get *Better Delivery*

—by getting in touch with the products and speed of delivery of 35,000 U. S. manufacturers through—

Mac Rae's Blue Book

By having this book close at hand, you are in immediate touch with every large manufacturer in the United States. It gives you, in condensed form, catalogs and selling talks of nearly 2,000 manufacturers—it gives you 10,000 trade names and the names and address of their respective manufacturers—the names of manufacturers listed under 15,000 classifications of the products that they make—and in addition, many hundreds of pages filled with information of great value to the man who specifies or buys materials and supplies.

Purchasing Officials, Contractors, Contracting Engineers

—make up the greater portion of **Mac Rae's Blue Book** users. If you have never had one of these books you should reserve a copy now.

Approximately 100,000 **Mac Rae's Blue Books** have been distributed during the past nine years, and 13,000 will be sent out this year.

Mail the Coupon Today

By mailing the coupon below you make sure of getting your copy. The saving you make on one small order through the use of **Mac Rae's Blue Book** will more than pay for it. Reservations for this book are being made daily—the sooner you make yours, the more sure you are to get your book. We send you the book on trial as soon as it is off the press and bill you for $10.00 after you express your desire to keep it. The coupon simply reserves one for your acceptance. When the 13,000 are gone no one will be able to get another copy of the 1920 issue.

Mac Rae's Blue Book is recognized to be the greatest industrial buyers' guide of any book on the market. Every branch of the government's purchasing department has one—every firm that does buying *should* have one.

Fill out the coupon and mail it today.

Mac Rae's Blue Book

Railway Exchange Building
CHICAGO

COUPON

Mac Rae's Blue Book
Railway Exchange Bldg., Chicago.

Gentlemen: Please reserve for me, one copy of the 1920 edition of **Mac Rae's Blue Book** for free inspection. It is understood that if I decide to keep it after examining its contents, you are to bill me for $10.00 to cover its cost. If I don't want it, I am to return the book at your expense and thus end the transaction with no further obligation to me.

Name _____

Address _____

Position _____

City _____ State _____

country's business at large will in a great measure depend upon the motor truck. Local freight trains are going to give way to motor trucks or caravans of them if necessary, for the truck is efficient and it furnishes a quick and economical way to transport materials and commodities.

Every winter we see congestion on the railroads that must be relieved if our industries are going to expand as they have a right to expect. The relief is going to come by passing the short hauls to the motor truck. The result of this will be not only an increasing use of the truck, but an increased efficiency for freight service as well.

Motor trucks are like any other expensive pieces of equipment—they cannot remain idle for any considerable part of their working day and return the best profit on the investment. They must work all the time and it is for this reason that motor truck manufacturers and users should sponsor such movements as are being inaugurated for return load service in various parts of the country.

Trucks Should Work Full Time

There is but very little difference between the wear and tear in a return trip when the truck is empty and when it is loaded. The cost of operation and upkeep are also practically the same. Furthermore, the damage that the empty truck does to the road is about the same as it would be were the truck loaded; and while it requires a little more power, a little more oil and a little more gasoline, when the truck is loaded, this difference is not as large as might be expected. It is essential, therefore, that motor trucks and their drivers must, for the sake of economy, be made to work full time instead of half time.

In many parts of the country farmers are now sending their produce to the market by motor truck. These carriers are traveling over all roads every day and if they are not yet, as a general thing, carrying loads back, it is because the truck men or their patrons do not yet see the profit that will accrue to them, perhaps through quicker service, in the use of these motor trucks for return loads.

Trucks are offering a particularly valuable service to the wholesaler. Many of his problems and the problems of his shipping clerk and traffic manager are solved. The haul to the freight depot and the reloading is eliminated; and merchandise consigned to some nearby town is delivered at the door of the retailer and the merchandise arrives in better condition than by rail.

Truck Efficiency Benefits All

But the wholesaler is not the only one who benefits. The retailer is helped too, for he is in daily touch with the city, his supplies can be ordered as he wants them, and it is not necessary for him to carry as large a stock of goods and have such a large outlay of capital.

Meat dealers in Niagara Falls, for instance, can order meat from Buffalo before four o'clock in the afternoon and it will be delivered by motor truck before noon the following day. Before this work was done by truck it required two and sometimes three days to make the same delivery.

The excitement that used to come with the "rush" order is eliminated, for the rush order of the past is the usual thing when the delivery is made by truck.

With the advent of the truck in the farm field, the great markets of the world are open to the farmer. He makes more profit because now he can sell on the exact day he wants to sell. His markets are enlarged, too, for the city stands ready to consume or ship all his produce and do it without quibble.

And as soon as the farmer sees increased markets, he can see the benefit of increased acreage. The result is that more food stuffs will be produced. The city man will pay less for his fruit, meat, vegetables, butter and eggs, but the farmer because of increased production has made more money; and the man of the city gets better milk—better food in general—because the motor truck is hauling his food stuff to him over the highways.

A better and larger social scheme cannot help but result from increased use of the motor truck. The visualization of its utility is by far the best argument for better roads and better care for them that has yet been advanced; for it is on good roads that the motor truck can do its best and most efficient work winter and summer.

FULLY EQUIPPED MOTOR TRUCKS

By A. E. Schafer, General Sales Manager, the Gramm-Bernstein Motor Truck Co., Lima, Ohio.

I presume I have been asked to read a paper on the subject of "Fully Equipped Motor Trucks," because of the fact that my company happens to be the first publicly to advocate that practice, though, perchance, it may not have been the first to have seriously thought of it, rather than because of any superior knowledge which they or I may have on the subject, and I shall, therefore, attempt to treat it from that standpoint and in doing so, give you without any bias, the benefit of our experience and observations.

Let me preface all my remarks by saying that in our opinion there is nothing new or novel in the proposition, but that instead, to our minds, there exists a real demand for what we are doing, backed by sound merchandising sense and well established precedent, all of which definitely point the way we are headed.

A Lesson from the Passenger Car Industry

If you will pardon a personal allusion, I would like to take you back to 1910 when the passenger car industry was in its swaddling clothes and a state of more or less chaotic transition. All manufacturers were then groping and striving to know the wants of the market. At that time I was a motor car manufacturer on my own account, doing business in Cincinnati. Our company had been making some thousands of horse drawn vehicles a year, and of course, had some "horsey notions." That at least was what we were accused of, when we threw a bomb into the trade by being the first to announce a fully equipped passenger car. Such equipment then included acetylene gas generator, lamps, bulb horn, top with curtains, windshield, speedometer, foot rail and robe rail.

My partner and self were roundly berated and called all sorts of things for our stupidity in giving away so much that had previously formed the basis of extra profits, and the prediction was freely made by the wise ones in the industry, that the movement would begin and end with us. However, all of you here know whether it did or not. So much for precedent.

Now I simply want to say in passing, that while the automobile sales manager did for some years plume himself and arrogate to his position a super-knowledge of marketing and as he styled it "how to put it over," I for one have never been able to see where he has taught gen-

eral merchandising anything, except the two valuable features of getting advance cash deposits on future contracts and selling his goods sight draft with bill of lading, both of which were invented, born and nurtured, of necessity.

Outside of those features the nearer he has followed well established stable ideas of merchandising, the stronger and sounder his organization has become. General sales management to my mind at once implies professional merchandising ability, in the exercise of which we all of us in better or poorer fashion attempt to learn what is the public demand, what is the line of least resistance in meeting that demand, and the best way to work in harmony with both.

One of the tests I like to put to any question is "how I would like to be approached with it," as well as "will doing it in a particular way conduce to the ultimate best good of the industry."

Cabs

Now to start with, you all know that except in very isolated cases, no truck can be used without a cab of some sort, as protection to the driver, and if a cab, why not a type which will make driving comfortable for all weathers and climates? That being so, doors, windshield and curtains are indispensably necessary.

When attending a Truck Owners' Conference here in Detroit a year ago, one of the speakers referred to the fact that one of the greatest difficulties they had been up against was to get good drivers—that they had first tried their former teamsters, but as they were the poorest and most unreliable class of labor known, they naturally were not successful as motor truck drivers.

Someone thereupon asked why it was that teamsters were so bad and the speaker replied that, on account of their having to be out and unprotected in all kinds of weather, it was impossible to get a man as a teamster who could do anything else.

That being so, does it not point the way to better truck drivers and consequently better results with trucks for both maker and user, if we can so equip them so as to attract a higher class of help.

Now in progressing further on the subject, let us start at the front of the truck and work back.

Radiator Guards

Take the Radiator Guard—there are enough of these bought and paid for as extras each year to convince any one that there is a real need for them, and just to the extent that trucks multiply in number just to that extent will the need for guards increase.

The radiator of any automotive craft is by reason of its location, character and function a vulnerable and vital unit, hence it is only good sense to protect it from damage, not alone on account of the cost of repair but for the more urgent reason of obviating a lay-up of the truck.

In fact, anything that can be done within reason to keep trucks out of the repair shop and in active service will conduce to their wider use and the greater prosperity of the industry as a whole.

The Motometer

The Motometer is another small but valuable piece of equipment we have found, because by its tell-tale qualities the driver is quickly informed if he has overlooked filling up with water or oil, or if for any reason, either one had leaked away, fan belt had broken, water pump key had sheared off, oil pump or lines had broken or clogged, etc.

Under any of those conditions, motors heat up quickly, especially under heavy duty and slow running, and if conditions are not promptly relieved, scored cylinders, burned out bearings and other serious troubles ensue.

Electric Generator and Lights

It seems almost needless to argue in favor of, or as to the necessity of, electric lighting equipment as against oil or Prest-o-lite gas, because, while when Mr. Gramm first exhibited an electrically lighted truck at Madison Square Garden in 1910, such appliances were not satisfactory and with their batteries would not successfully withstand the rough jolting of hard tired trucks, still all of you know from your own experiences that Electric Generators with Lights are thoroughly satisfactory these days, and in fact, where trucks are driven after night-fall, especially in interurban work, there is no other form of lighting that can at all compare with it.

You would scorn the man who would try to induce you these days to accept oil or gas lights for your house or passenger car; therefore, is there any reason since electrical lighting equipment is now made right for trucks that you should try to palm off something passe and antique on the truck buyer, simply because you can get away at a less cost.

Electric Horns

With the installation of electric generators and heavy duty batteries an ample supply of "juice" is assured, so there then remains no reason to equip with hand horns as against the better and easier operated electric horn. In fact, it can be easily proven that many a costly accident

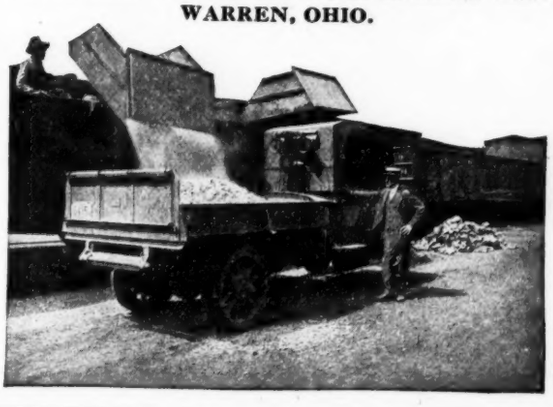
Four Men Sat Idly Swapping Stories

They were in a gondola car. The car was being emptied of gravel, but the men had nothing to do. The trucks were away and so they could loaf for 20 minutes. Meanwhile their pay went merrily on at sixty cents an hour. This happened four times a day. When the trucks came back it would take 20 minutes to load each one. Meanwhile the truck stood idle.

Think what the owner would save if he used **Heltzel "Lightning" Loader Skips.** The trucks could load in two minutes, and the men would be continually busy filling the Skips. His costs would certainly be materially reduced.

A "Lightning" Loader Skip is the most expensive equipment—to be without.

The Heltzel Steel Form & Iron Co.
WARREN, OHIO.



has been averted by the quicker and better warning given by the more modern signal.

Hub Odometer

Passing to the Hub-odometer, which some have argued is not a necessity, largely because they do not equip with them, may I ask how else in reason the owner may determine the mileage his various trucks make, what his cost is per mile for gas, oil and tires, secure proper tire adjustments, etc., or how often he should drain his crankcase in various seasons to keep his lubrication on the safe side?

Army Towing Hooks

Next comes Army Towing Hooks: I wish I could have had some of you gentlemen down at our plant a few weeks ago when one of our old chain drive, 6-cylinder trucks was being towed in from somewhere up the state, on account of a connecting rod having let go and gone thru the case. It was one of the heavy duty type dumps, capable of about 7 tons and consequently some load to drag along.

Needless to say, it did not have towing hooks as part of the equipment and so the towing was done by means of a chain around the front cross member, while the fellow who did the towing also did not have a draw-bar, and consequently both front and rear cross members were pulled entirely out of shape and alignment.

In the case of the dump it was necessary not only to heat and straighten out the front member but also to rerivet the front spring brackets, as well as put in new rivets further back, where they had been started by the distortion at the front end.

Needless to say, that notwithstanding the age of the old chain drive, its owner authorized towing hooks added to the repairs.

Spring Trailer Draw-bars

The foregoing applies equally strong or stronger, to the need for Spring Trailer Draw-bars, without which serious damage may result to the rear end of any truck towing another by reason of distorting rear ends and loosening corners, thus allowing transverse frame action, bending of rear shackle bars, etc., etc.

There is also another very great reason for the addition of that equipment and that is to increase the efficiency and economy of the motor truck as a very modern medium of transportation, by hauling one or more trailers.

The trailer manufacturers have been wide awake and active; they are educating the truck owner along trailer lines and we are not wise as sales managers if we do not insist on our product being equipped to meet these newer conditions.

Dealer's Interest in Fully Equipped Trucks

Now, just a brief word in behalf of the dealer's interest in this matter and I am done. Would you buy a passenger car stripped and then start all over again and buy top curtains, electric lights, horn, robe rail, foot rail, extra seats, etc., etc., or would you demand that the dealer price complete such an outfit as you told him you were looking for?

Or, if you were on the dealer's side of the fence, would you like first to sell a man your truck and then go back after perhaps a hard wrestle on the major sale, and have to go all over the case again by selling him piece meal the things you call extras, but which you know are actual necessities and the lack of which would not enable him to operate his truck as satisfactorily and economically in the long run?

How many dealers are there, also, who when it comes to these so-called extras, get full price for them?

Do they not instead, give many of them away entirely, thus forming only one more avenue for insidious price cutting and constantly reducing their average margin of profit, a thing we should all labor against, because if the dealer does not make a proper and adequate profit, he will not continue long to handle any line but *will continue* to change until he finally gives up truck selling altogether and tackles something else more profitable.

Now I believe that this Association, young as it is, has already impressed much of the automotive trade of their intention and ability to do constructive things for the industry. Therefore, why not rise to the occasion, standardize on what shall continue a complete Motor Truck chassis and thus be the Moses that shall lead the trade out of much of the wilderness of irregularity that has obtained and into the promised land of a more stabilized condition with resulting better profits?

We say emphatically, "don't put off the evil day," if you must call it that, but recognize the changed conditions and necessities of the trade and sell your product fully equipped.

Acknowledgment

The foregoing paper by Mr. Schafer was presented before the National Association of Motor Truck Sales Managers at Detroit, Mich., on Nov. 7, 1919.

THE MOTOR BUS VS. THE STREET CAR

By R. E. Fulton, Vice President, International Motor Co., New York, N. Y.

In a consideration of the reasons for the growing acceptance of the motor bus as an economic necessity in passenger transportation, it is well first to examine the ultimate effect of increases in population upon traffic facilities. While the necessity for immediate action to solve serious congestion problems is now being felt only by the larger cities, the requirements of smaller cities and their future development deserve just as much consideration to prevent this congestion in years to come.

Traction Lines

Traffic facilities may be divided into two classes, public utility transportation lines, and highways to accommodate privately owned vehicles.

It is evident that the traction lines are becoming more and more indaequate to handle the congestion that is increasing every day. Since the amount of traffic they will hold is limited by the tracks on which they run, it will be impossible for them to keep up with the growing needs of transportation unless new tracks are laid. This, however, is prohibited by the increasing congestion of privately owned vehicles on the highways. Increasing population on the one hand demands more public transportation facilities. The increasing number of privately owned passenger and commercial vehicles on the other hand demands better highway facilities. Can one factor be satisfied except at the expense of the other?

The present serious financial condition of these public utility corporations throughout the country is bound to mean increased fares, and the burdens imposed upon them by increasing population is bound to mean more and more

congestion. The motor bus will not only solve the serious traffic problem, but will provide the public with a more flexible, satisfactory mode of transportation at a lower cost.

Motor Busses to Relieve Congestion

In the majority of large cities it is out of the question to lay more tracks for surface car lines in thickly populated business and residential sections—there is no room for them. In view of this fact it is only logical to assume that motor busses will be used to relieve the congestion, as they are free to operate on any route without tracks. And it is very possible that the time will come when traffic will have increased to such an extent that the streets will seem unable to hold it. In this event the only solution would be the discontinuance of surface car lines and the substitution of motor busses. This for the simple reason that busses do not block the highways, being flexible and able to move about in traffic. Surface cars, on the other hand, do block traffic—this fact cannot be denied.

As far as less thickly populated sections are concerned, there is every reason to believe that future development of transportation facilities will favor the motor bus. The laying of tracks for a surface car line represents a huge initial expense for right of way, bridges, grading and rails. If such a line does not prove profitable, it cannot be diverted. The flexibility of the motor bus system, however, does not confine it to any one fixed route.

Public utility corporations everywhere are gradually losing the faith of investors. Their inability to increase fares to keep up with increasing costs of operation considerably decreases their dividends. In view of this, it is becoming increasingly difficult to find investors who will lend the money to build and equip new traction lines, while far better inducements are offered in other securities.

Motor Bussess Successfully Employed

Efficiency and economy of operation are in favor of the motor bus. This has been proved in New York City by the success of motor bus lines established to take the place of traction lines that could not pay for themselves. Then, too, when Brooklyn traction companies raised their fares and people refused to pay the advance, a fleet of motor busses solved the problem by taking the Brooklynites to their places of business. They not only were able to operate profitably on the lower fare basis, but proved to be quicker and far more comfortable than the trolley lines.

These economies are principally due to the fact that the tremendous overhead expenses of the surface car lines are eliminated in the operation of motor busses. The bus is its own power plant and it consumes power only when in operation. Since it is speedier than the surface car, a bus can make more trips per day thereby increasing the revenue per unit of expenditure.

Advantages of Motor Bus Routes

Motor bus routes offer many conveniences that cannot be offered by traction lines. Another point—they unload passengers at the curb which is much safer. In case of a blockade, a bus can detour. This fact alone works as a benefit in two ways—it makes a more dependable transportation system and tends to relieve the congestion incidental to blockades. Not being confined to tracks, busses can receive and discharge passengers nearer to their homes. Then, too, we have the obvious fact that people would rather ride in a motor bus not only because of its conveniences but because of the suggestion it conveys of pleasurable outdoors.

A movement that had its inception in California and that is gradually spreading to other parts of the country is the use of motor busses to provide better educational facilities. By the consolidation of rural schools and the use of busses to carry the pupils to and from them, a more complete curriculum is offered to the children in rural districts. This is but one instance of the adaptability of the bus in the development of sparsely populated sections. Where a traction system is needed, but is too costly to be profitable, the economical motor bus can be relied upon to fill the need.

There are seasonal needs for transportation service that can only be filled by the motor bus. Summer resorts, for instance, often cannot support a surface car line the year through, while the bus can be diverted to other channels out of the busy season.

The motor bus is also a big factor in solving the industrial labor problem. Factory sites within city limits where labor is available, are scarce. The use of busses to carry employees to outlying sections where sites are obtainable is gradually being recognized as the logical solution to the problem.

3½-TON MACK MOTOR BUS WITH SEATING CAPACITY OF 30 PASSENGERS.

This bus is equipped with a generating and storage battery set which furnishes the current for dome lights running longitudinally along the ceiling on either side. Silk faced pantasote roll curtains and interior draperies together with reversible, forward facing upholstered seats give a luxurious effect. Passengers enter the bus by way of a folding door operated by the driver. Heating is arranged from the exhaust of the motor through pipes along the floor, covered by a metal grill. Sewell wheels have been used for softer riding. The tires are Goodyear.

A short time ago a party of ladies left Easton, Pa., in a pneumatic tired motor bus to attend a matinee theatre performance in New York City, a distance of 73 miles by train. They left in the morning, arrived in plenty of time for the matinee and returned to their homes in the bus that same evening. Such illustrations of the potentialities of the motor bus make it easy to conceive the time when commuters will travel to business in busses more quickly and comfortably than by means of suburban trains. Metal laid roads designed for one-way motor traffic with no speed limit are inevitable.

All through the development of passenger transportation in every section, from the large city to the rural community the motor bus will be felt more and more as the years go by.

HAUL IT IN A HALL

DUAL MEANING *of* "TRUCK SERVICE"

AS applied to the truck industry, the word—"SERVICE" has a dual meaning.

It indicates those mechanical and structural qualities in Motor Trucks, which ensure truck purchase satisfaction through definite, dependable, OPERATING SERVICE.

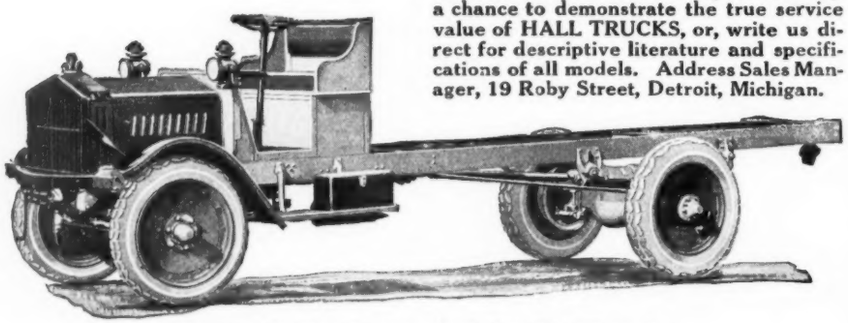
It represents the physical ability, as well as the will of truck manufacturers to furnish SERVICE through prompt delivery of replacement parts, made necessary by accidents or honorable old age.

HALL TRUCKS are a complete exemplification of the possibilities of both classes of "TRUCK SERVICE".

That's only natural, however, because the makers of HALL TRUCKS, as an organization, have been carefully and systematically establishing throughout the past 46 years a reputation for conscientious business dealing that is exceedingly valuable and worth maintaining at any cost.

That's only one of the reasons why a better truck than the HALL or a more complete or satisfying service than HALL SERVICE, does not exist. *Let us prove those claims.*

Give the HALL DEALER in your territory a chance to demonstrate the true service value of HALL TRUCKS, or, write us direct for descriptive literature and specifications of all models. Address Sales Manager, 19 Roby Street, Detroit, Michigan.



Pneumatic Tire Equipped—2-Ton Hall Chassis

As Manufactured by
The LEWIS-HALL IRON WORKS
DETROIT, MICHIGAN.

EDITORIALS

ATTRACTIVE HIGHWAYS

It is estimated by some authorities that appropriations of funds for the construction of hard surface roads in the United States in 1920 will reach a total of one billion dollars. This is five times greater than the previous maximum yearly expenditure. Now that the era of greatest activity in road building has come let us give proper consideration to the beautification of improved highways.

There has been too much cutting and slashing, too much clearing and grubbing in connection with highway construction. The natural beauty of the highway should be safeguarded. Many road builders have sanctioned the wanton destruction of bushes and small trees at the roadside. Let us take care that in improving a roadway we do not transform a beautiful drive into a barren highway. As one observer says: "This change from the beautiful to the ugly has not been called for and should not have been permitted." It is recommended that each state highway commission employ a landscape architect to supervise the conservation of the natural beauty of the highway and to plan for the embellishment of unattractive roadsides. Every individual should do his share in this work of beautification.

"David Grayson" and others have written of the lure of the "friendly road." Many "adventures in contentment" are experienced by travelers on the highways. The highway is as old as the race and the urge to travel on it is an even deeper-rooted instinct in man than his desire to live in a house. The railroad is a modern and noisy device that restricts the freedom of movement and soon wearies the traveler. Travel by water is often necessary but usually unpleasant. Travel by air is still a defiance of death and but little more. Not only is the air traveler supremely uncomfortable but he is deafened by the roar of his motor. He gets but an inverted and distorted view of the earth. Air travel may be successfully commercialized but it can never provide much pleasure to man who by nature is a groundling. But travel on a pleasant highway renews youth and restores the soul.

Wherein lies the pleasure of motoring over a good country road? It is not merely in the motion for that is more easily experienced on the city boulevards. It is not in the droning of the motor except to the occasional driver who is interested only in the operation of a piece of mechanism. The real pleasure in highway travel comes from looking at the swiftly changing beauty of the landscape. Where such beauty is absent there is no joy in highway travel and one takes the shortest cut back to town.

Let us make and keep our highways attractive.

THE SMALL ENGINEERING JOB

A contributor to this issue comments on the fact that early in his career as an engineer, with the wealth of descriptive matter available, it would have been easy for him to surpass such works as the Sweetwater Dam or the Croton Aqueduct; but when it came to designing or detailing the every-day, average structure of moderate cost, especially with the inadequate funds generally available, in all the realm of engineering literature he found scarcely a word for his guidance.

In over twenty years of practice he has learned that the majority of engineering problems are not of great dramatic interest, but that there is much good engineering done in achieving success in modest undertakings with insufficient funds.

The contributor states that within the past five or six years there has been a marked change in the character of matter published in engineering journals and that today such journals contain much matter of interest to the average engineer.

While it is gratifying to learn that a careful observer has noted such a distinct improvement in technical journalism we feel there is yet much room for improvement and in the same direction. We believe practically all the editors of engineering journals, with possibly one exception, would gladly make their papers of more interest, and value to the average engineer if they could.

For a long time the fault rested with the editors who filled their journals with descriptions of work of such exceptional magnitude that they not only failed to help the average practitioner of engineering but gave him an undeserved feeling of insignificance. Now the fault rests with the average engineer who feels that his work is of interest to none but himself and he cannot be hired, coaxed, wheedled or cajoled into writing anything whatever about it for publication. Many engineers insist that their work is so commonplace that a description of it would only invite ridicule.

If engineers, as a class, ever become willing to write about their handling of interesting and important, though small, pieces of engineering work for the benefit of other engineers, they will find the engineering paper editors very quick and very willing to co-operate in the dissemination of such information. We are speaking now in constructive and friendly criticism of

engineers as a class. That many individual engineers do write of their work is obvious from the fact that engineering societies and engineering journals keep on functioning. These exceptional men make the journals and the societies possible and worth while. If all engineers would regard it as a professional duty to tell of their work the engineering papers would be much more interesting and useful than they are now. They would not cost more but they would be worth more.

We are constantly seeking articles pertaining to

OUR GREATEST GAIN FROM THE WAR

The cost of the great war to the United States was considerable in men and enormous in money if we consider the great war debts as so much money lost. But to regard these debts as money lost is an economic fallacy when viewed broadly for one man's loss was the gain of another. There was a great shifting of credits but the actual destruction of our wealth was not great.

When we consider our gains from the war we find these far outweighing the losses. The moral leadership of the world is undoubtedly ours, though temporarily clouded, perhaps, by the prolonged deadlock on the ratification of the peace treaty with its league of nations covenant. Those who lightly dismiss this moral leadership of the world as a matter of but idealistic or academic interest should not fail to consider also its intense practicality. It amounts to nothing less than a firm grip on the good will of the world and the value of good will in business dealings between nations is of the same quality that governs the transaction of business between individuals. That the highly idealistic and moral sides of our leadership during the war were exceeded only by its intensely practical side is a fact much better appreciated by the average European than by the average American. We have an overall check on the truth of this statement in the fact that we were a debtor nation at the outbreak of the war and we are now the greatest creditor nation.

The changes in our economic relationship to the rest of the world are all in our favor. Materialists have little to complain of in this respect if they can disabuse their minds of political prejudices and consider results rather than the methods employed in getting the results.

But the great improvement in our relative position in the economic world is not our greatest gain from the war. There is another and a greater gain, one more closely touching the daily lives of all of us. That gain is the secure confidence of the American business man in the United States as a tremendously fortunate, rich and independent going concern.

Before the war it was distressing to observe the timidity in business of both big and little business men. Every time stocks went off a point the big fellows began to grow frightened. A drop of two points produced a near panic, while a drop of five points was the signal for a rush of the big fellows to the cyclone cellar. The little fellows, with their teeth chattering from fright, were only one jump behind. That was indeed a sad spectacle and one we were often forced to look at. Since the war we have learned that the end of the world does not come easily; that the economic structure can assimilate a vast amount of punishment. The stock market is not as flighty as it was, which is an important gain from the war, and the people pay less attention to the stock quotations than they did before the war, which is an even greater gain.

So we conclude that our greatest gain from the war is our liberation from the fetters of fear that once bound us. We are all energetically transacting business, unmindful of the fact that as a nation we have accumulated a tidy debt. We are paying very high prices for everything, magazines possibly excepted, and while we don't know where we are going we are having a perfectly good time on the way.

We have reached another presidential year; a windy year with incessant gas attacks. Yet the people are largely unperturbed, realizing, somewhat vaguely perhaps, that the country will be saved again this fall and every four years thereafter as long as we have tremendous natural resources still undeveloped.

It is this indifference to daily disturbances to business of one sort or another, on the part of the American people, that constitutes our greatest gain from the war. This generation has learned to go blithely about its business, to be "up and doing, with a heart for any fate."

PROFESSIONAL MEMOIRS OF EX-SERVICE MEN

A year ago it was to be expected that professional men released from military duties would enrich the literatures of their several professions with accounts of their activities during the war. Such accounts still possessed some news value a year ago and some interest, despite the keen desire of most engineers to forget the war as soon as possible.

But we are dismayed to find that the flood of these professional memoirs is not receding very fast. Examination of the programs of engineering society conventions being held this winter reveals many examples of these throwbacks to scientific barbarism.

We beg leave to suggest to the various colonels, majors, captains, etc., that if they have pent-up, scientific, war stories bumping against their brows that these be released for publication through the periodical called Professional Memoirs which, as we understand it, is the proper repository for such literature, made and provided by the engineer corps of the United States Army. In that place such writings are always in season. If published there they will reach the greatest number of interested readers and will be preserved to future generations of warriors and, we freely concede, may be of immense value later on.

The Construction of Brick Pavements In and Near Danville, Illinois

By Harlan H. Edwards, City Engineer, Danville, Ill.

Danville, Illinois, a city of about 40,000 population, and one of the homes of the paving brick industry, has probably as many brick surfaced streets of various types and ages as may be found in the middle west. Starting from the paving of a few main streets in 1890, the mileage of brick paved streets has rapidly increased to a total of 45 miles which is about 98 per cent. of the total paved mileage in the city. In this mileage about every type of brick pavement in existence has been constructed. Starting from the original type of two course brick pavement or one course brick on a gravel or stone foundation, the types run through brick laid on natural cement concrete base or Portland cement concrete base with sand cushion and sand filler to the higher types of filler—asphalt, pitch-mastic, and cement. Many lessons have been learned from these pavements and the design of many streets have been benefited thereby. The work just completed and work now under way for construction in 1920 have shown the result of careful thought and investigation concerning the price of materials, character of sub-soil, and density of traffic to be expected on these streets. On one street several thousand dollars were saved by utilizing an existing old brick base, while on another street money was saved by reducing the thickness of brick required. Many other like savings will be made during the coming year to offset the additional cost of paving caused by high labor costs and freight rates. In order to understand some of the reasons for the changes which have been made in the past two or three years in brick pavement construction, it is necessary that a brief resume be made of the development of the brick pavement.

FOUR INCHES OF BRICK ON A ONE INCH CONCRETE BASE.

Development of the Brick Pavement

The earliest brick roads were constructed with what is now considered common building brick, placed on tarred boards on compacted earth or gravel, and covered with a layer of sand to smooth over inequalities of the surface. The interstices between the bricks or the "joints" were filled with sand, and the road opened to traffic immediately. This surface was better than dirt, especially in wet weather, but since there was little or almost no base to distribute and carry the load these pavements were suited principally for light traffic. In order, therefore, to provide a better foundation, a layer of brick was placed flatwise on the earth and gravel, a layer of sand or fine gravel on top of this, and upon this bed the wearing surface or brick was laid on edge. This type of surface made a more nearly water proof cover, keeping the earth foundation drier and consequently giving it better bearing capacity.

Since these pavements were made of relatively soft brick varying somewhat in hardness and toughness, they soon wore to an uneven and bumpy surface. This wear could not be determined beforehand, for the Standard Rattler Test had not yet been developed. Furthermore, on account of the installation or extension of water, gas, or electric conduits, trenches were excavated in the streets which by being poorly backfilled, often left bumps or depressions in the pavement. In spite of all these defects, many of these old pavements are still in existence as evidence of the long life of this type of pavement. Several streets of this type now 30 years old are still giving good service with little or no maintenance and will probably continue to do so for years.

Introduction of Concrete Foundation

As the price of cement became lower, concrete was gradually introduced as a pavement foundation. At first the concrete was of a poor quality, but it increased in strength and uniformity as its use became more common and equipment for mixing it was improved. The development of the concrete mixer progressed from the continuous mechanical mixer to the batch mixer which is standard now and which has proved the most efficient for the production of good concrete.

MONOLITHIC BRICK PAVEMENT 9 FT. WIDE, 5 IN. SLAB, STOCKLAND TWP., IROQUOIS COUNTY, ILL.

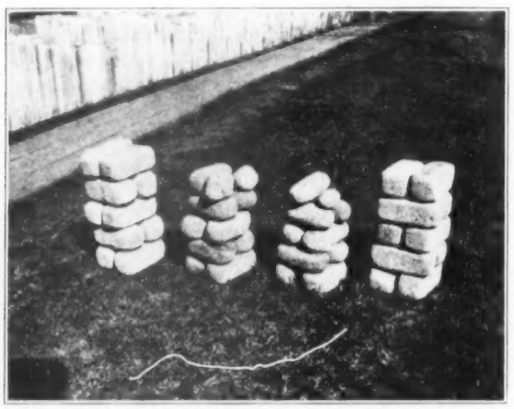
Origin of Sand Cushion

The first concrete foundations being rough and uneven, made it necessary to continue the use of a layer of sand to take up their inequalities and provide a smooth even surface upon which to lay the brick. This was the

reason for the use of the so-called sand cushion, and was the origin of our sand cushion pavements, which are still being used except when cement filler is used between the bricks. As Portland cement became cheap enough to be used in pavements, various methods of obtaining a more smooth and even surface were developed until now the better class of work produces foundation surfaces varying little more than ¼ in. from a straight line. Thus we see the need of a thick sand cushion decreasing to the vanishing point.

Sand Cushions Work Up in Joints

After the brick were laid by hand in regular courses and rolled to a smooth even surface with a heavy roller, variations in the character of the sand cushion became evident. Some sands, if not previously compacted, worked up between the bricks, filling the joints from one-half to three-fourths full. This made little difference if the joints were to be finally filled with sand, but if a higher class or more expensive form of filler were to be used, it



DOES TESTING PAY? 12.2%, 35%, 43%, 11%.

often necessitated the taking up and relaying of the sections so affected. The importance of this became more pronounced as the filler became more rigid.

Kinds of Fillers

The three forms of fillers used are the sand or granular, the bituminous or plastic, and the cement or rigid, types. Of these, the first is the most simple and least expensive. It, however, affords no protection for the edges and corners of the brick but allows them to become rounded; making the surface of the pavement rough. With the abandoning of the lug brick except for rigid fillers, and the adoption of the straight wire-cut brick with its narrow joints, this objection has been almost eliminated. When the bituminous filler is used, applied in a hot and quite liquid state, little difference is made whether or not the joints are free from sand. The rigid filler, however, necessitates clean joints the entire depth of the brick, for otherwise serious trouble will be caused later on. As this is the cause of the greater number of brick pavement failures, it might be well to consider it more in detail.

Grout Filler

In the cement or "grout" filled pavement, it is essential that the joints be free from sand or other foreign material, and be filled the entire depth of the brick, thus cementing the separate brick into a solid slab. As the temperature rises and falls, the slab must expand and contract. Since the brick are in a solid slab having no allowance made for expansion, this expansion can take place only to a very slight degree, and instead great internal compressive stresses are set up. If the joints are filled solidly, the center of compression will be through the center of the slab, distributing the stress equally over the entire depth of brick. If, however, the joints are filled but one inch or less at the top, the stress comes entirely on this small section, and is often enough to shatter the brick or crush the cement filler, destroying the bond, and ultimately subjecting the entire pavement to wear the same as a sand-filled pavement. This failure by crushing, however, seldom comes in the entire pavement, but rather comes in spots where the grout had been carelessly applied, or of such thick consistency that it failed to penetrate the full depth. More wear is caused at these spots from the hammer-like impact of heavy wheels over the uneven surface, ultimately resulting in ruts or depressions.

Again, water penetrates these opened joints and its lubricating qualities combined with the vibration from traffic causes the sand to shift and compact, leaving a hollow space under this part of the slab. As traffic moves over this and adjoining sections, great shearing and tensile stresses are put on the grouted joints, ultimately causing their failure and consequently increasing the area of failure. Wherever expansion joints have been placed, this same action of water seeping in at the joint has caused the failure of the adjacent grouted joints, resulting in bumps, ruts, and crushed brick at each place. This destructive action is often hastened by the freezing and consequent expansion of water in the sand cushion.

Still another and often more dangerous occurrence, due to faultily filled joints, is the "blow-up." As the internal stress or pressure due to expansion increases, the resultant pressure, applied through the upper part of the brick slab maintains a great tendency toward upheaval, held down only by the weight of the pavement, since there is nothing in the lower part of the joints to resist. On hot days, this pressure sometimes becomes too great, and the whole pavement at the weak section is thrown up with great force, not unlike an explosion, throwing brick many feet in the air and endangering everything in the vicinity. It is with the elimination of these defects, then, that the engineers and contractors are mostly concerned.

Destruction Caused by Poor Filler

More miles of good brick pavement are destroyed annually by this careless, imperfect application of the cement filler than from all other causes put together. As before stated, when the sand cushion was used "inspectors" (many times political henchmen hard up for a job) often permitted repeated rolling of the brick, thus working the sand up very near the top of the joints. The result speaks for itself. West Irving Park Boulevard, Chicago, is a very good and recent example of this wanton destruction of good paving material by poor workmanship. Although it has been laid but 2 or 3 years, its surface, which should have lasted 30 or 40 years, in many places has been shattered or heaved by expansion stresses. Nearly every city has such examples, and Danville is no exception. We have a road running south from the city

toward Westville, which, although it has been built only about 10 years, has needed extensive repairs in certain sections only because of the destruction caused by the cement filler and by the use of expansion joints. The same is true of many of the streets in the city built in this manner. The inevitable result is that the modern vitrified paving brick, one of the best road surfacing materials made, has unwittingly been given an undeserved bad reputation, which will take years to retrieve.

It is on account of the seeming impossibility in many places of securing contractors who can lay a cement filled brick street properly, that the use of the cement filler has been virtually abandoned, and bituminous or sand filler adopted. These are practically fool-proof.

Cement-Sand Bed

To eliminate these undesirable features of the combination of the sand cushion with the cement grout filler and to retain the good features of the cement filler, a mixture of cement and sand for the cushion was substituted. Where the concrete foundation was finished to a smooth and even surface, the thickness of this cement-sand bed was reduced in many instances to as little as three-fourths of an inch. This pavement was a distinct type developed for city streets, and from the start was a great success. Its object was not only to afford a uniform bearing surface for the brick, but since the mixture of cement and sand was converted into a mortar by means of a thorough wetting after the brick were laid and rolled but not grouted, the setting up of this mortar finally formed a rigid bed and overcame many of the defects of the sand cushion. In addition, it effected to a limited extent a union between the brick surfacing and the concrete foundation, thus giving substantially a semi-monolithic beam. The success of this type of pavement on heavy traffic streets has earned for it a very enviable reputation.

Types of Monolithic Pavement

With the introduction of the monolithic pavement, there began a new era in brick pavement construction. Since the brick were laid immediately upon the fresh concrete base, the problem soon arose as to whether a sufficiently smooth surface could be obtained on the concrete to receive the brick. Two types of the monolithic brick pavement therefore came into use, differing in the method of smoothing the concrete surface. In one was used a thin layer of dry mix composed of cement and sand proportioned about 1:3, spread directly upon the concrete by means of a double template, and followed by the immediate laying and rolling of the brick; in the other this intermediate layer is omitted and the laying, rolling, and grouting of the brick takes place immediately upon the smooth surface of the concrete, obtained by the judicious use of sliding and tamping templates.

Monolithic Pavement Requires Experienced Contractors

Although, theoretically, this type of pavement was almost ideal, practically it proved very troublesome. From the start, uniformity of consistency of concrete became the bugbear of every road contractor on this work. Wet gravel, dry gravel, large, small, coarse and fine materials each acted differently, all operating to produce a wavy surface in spite of all efforts to the contrary. A stiff, dry consistency was finally adopted, with great success. It finally became apparent, however, that smoothness could only be obtained by careful, painstaking efforts, and had only been obtained by the most experienced and particular road builders. Although it was adopted by many states as the only permissable type of brick road, the concrete base was made so thick and the mixture so rich that on a price basis, competition with the usual one-course concrete pavements was out of the question, so the brick road lost out. Engineers finally saw their mistake and in some places reduced the total required thickness of slab to a rational figure. The monolithic type of pavement, however, is walking the plank in the wake of the sand cushion, cement filled pavement, and seems to be in the discard except in localities where careful and experienced contractors are available.

Five-inch Monolithic Slab a Success

One section of road noted for its radical design might be mentioned, however. In Stockland Township, Iroquois County, Illinois, a monolithic brick 9 ft. wide and 6 miles in length was built in 1916, using a 4-in. brick laid on a 1-in. bed of fine gravel concrete; making a 5-in. slab. Although this slab was laid on soil varying from brown silt loam to clay, sand, gravel, timber soil and gumbo, it was practically all underlain by gravel, providing good sub-drainage at all times. In this work a very smooth

A GOOD GROUTED BRICK PAVEMENT, LAKE SHORE BOULEVARD, CLEVELAND, OHIO.

surface was obtained. Although to date this road has gone through three winters, it is in perfect condition and stands as an example of the saving that can be made if we are only willing to take into account the natural drainage conditions that exist in the various sections of the country. In 1916, this work cost $8,500 per mile and provided a good profit for the contractors.

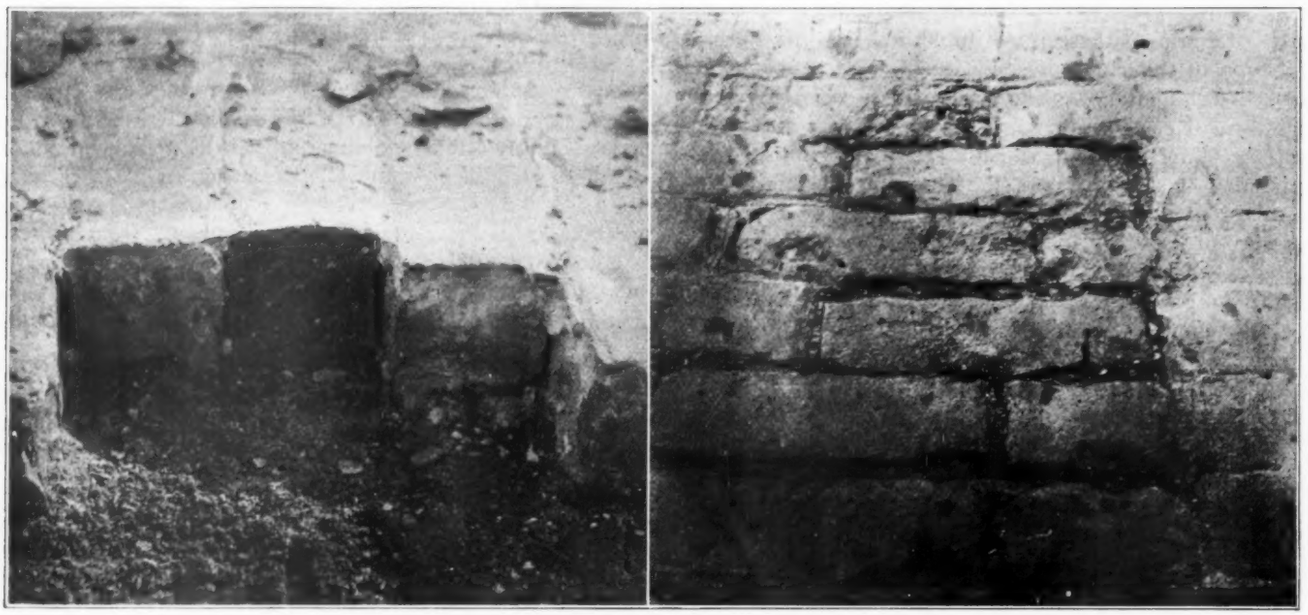
Resurfacing Easily Done Monolithically

Many of our old brick streets and country roads were built of soft brick that have worn rough under heavy traffic, making resurfacing imperative. This has been accomplished on the Danville-Batestown Road by brushing the dirt off the old brick surface and spreading a thin, smoothing layer of fine gravel concrete over it, upon

which the new brick surface was laid and grouted immediately. The old road, pounded down by years of heavy traffic, made an ideal foundation for the new brick wearing surface. Thus we obtained a new smooth wearing surface and a stronger road at half the cost of a new pavement.

Resurfacing City Streets Saves Money

To do this on city streets, however, involved additional difficulties in handling the surface drainage of intersecting streets. This was accomplished on Washington Avenue, Danville, which was a two-course brick pavement, by removing the upper course of brick and the sand cushion, spreading over the lower course of brick a smoothing layer of concrete not less than 3 ins. thick, placing a ¾-in. sand cushion on this and laying a 4-in. asphalt filled brick pavement on top. This was accomplished at a saving of about 25 per cent. to the property owners, and with the raising of the street level about 3 ins. This made necessary the installation of two additional storm sewer inlets to care for the drainage from an intersecting street, but did not impair the usefulness of the street in the least. Instead, it gave the city a heavy traffic pavement unequalled in carrying capacity and wear resistance.



POORLY FILLED JOINTS LEAD TO SHATTERED BRICK AND CAUSE TROUBLE.

Untested Materials Waste Much Money

Money has often been lost or wasted by the use of untested materials. Money spent in testing materials is money well invested, for it is an insurance against imposition and fraud. About five years ago, East University Avenue, Champaign, Illinois, was paved from the Illinois Central R. R. to Wright Street with an asphalt filled brick pavement, costing $50,000. Danville brick were to be used on the work, but for some reason only half the amount needed could be supplied at once so the remainder was obtained from a plant that has since then discontinued the making of paving brick. Danville brick were used from Wright Street to Fourth Street and the remaining distance to the railroad was paved with the other brick. No tests were made on this material, but within a year after laying, the section from the railroad to Fourth Street began to show signs of wear, and before five years were up, it was very rough. Samples of unworn brick were then taken out of the side of the street and tested. The results are shown in the accompanying photograph. The section built with Danville brick showed no wear, and maintained a smooth surface. They showed a loss of 11 and 12.2 per cent. in the Standard Rattler Test. The two samples in the center of the picture were of the second brick, which showed losses of 35 and 43 per cent. in weight. From the result of these tests it was decided to replace the greater part of these brick in the street with new material. More brick of the same make were obtained, tested, and rejected as unsuitable. Another lot was sent, but these, too, could not pass the test. Finally Danville brick were obtained and no further trouble was experienced. The lesson learned from this incident is expressed by the old saying: "'Tis better to pay grocery bills than doctor bills." It would have been much better to have paid for testing before the original pavement was laid than wait and have a $50,000 job go bad.

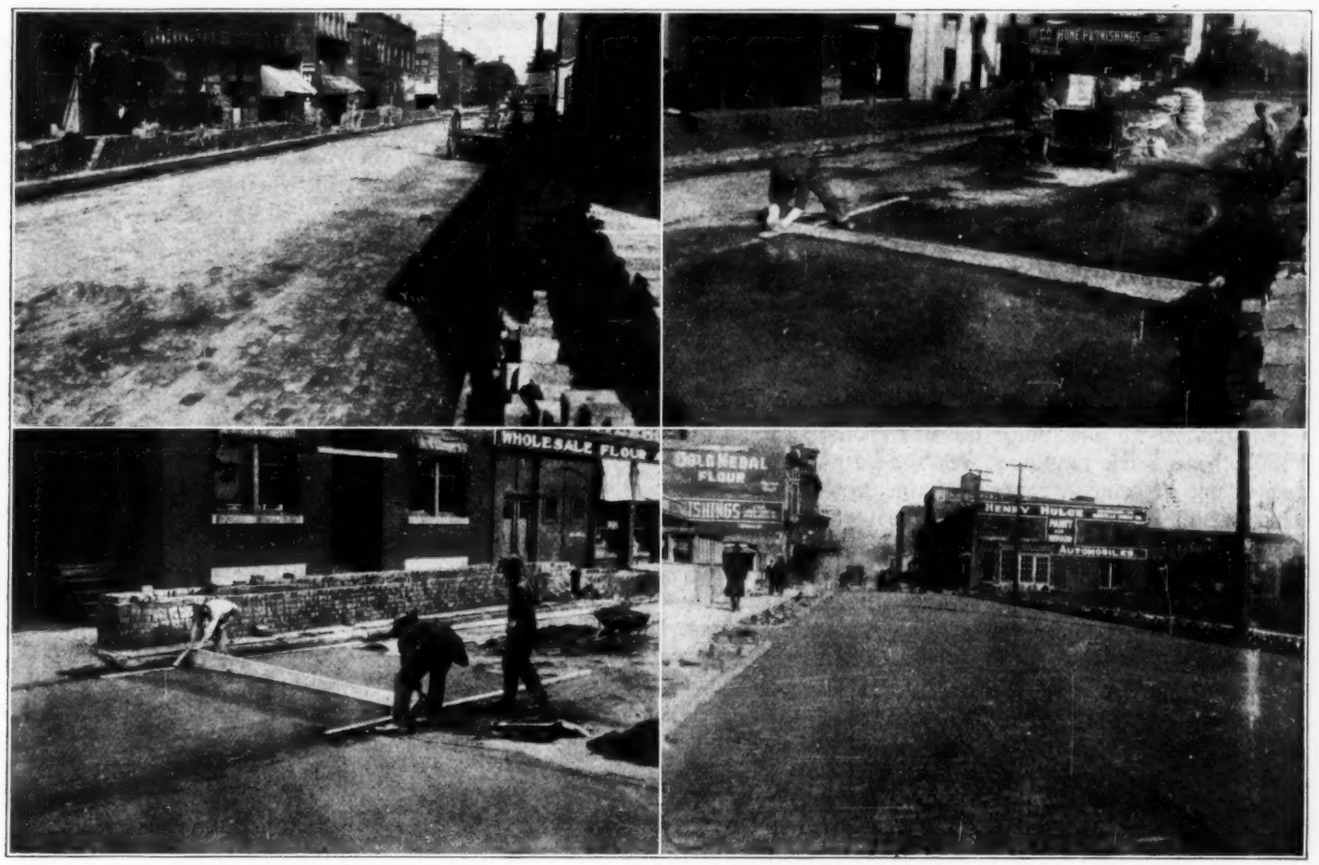
Rise in Prices Require Practice of Economy

The rising cost of labor, materials, and freight is leading to the practice of greater economy in street paving work for the coming year. With prices up 25 and 40 per cent. higher than those prevailing last year, tax payers are beginning to feel the cost of local improvements more than ever; and it is, therefore, necessary that every care be given to the design and construction of the street to reduce the cost to the lowest possible figures, consistent with safety. Wherever possible, old foundations of pavements are to be used, laying a new surface by methods similar to those used in the paving of Washington Avenue or the Danville-Batestown Road previously mentioned. In many places streets are repaved where the old paving brick are taken up and carted to the dump. Wherever possible and practicable, it is intended

to use these old brick by crushing, screening, and making into coarse aggregate for the new concrete base. The matter of crushing paving brick to be used in concrete for pavement bases is not, however, entirely a new idea. Detroit, Michigan, has used this in several instances and has obtained coarse aggregate from the paving brick at a cost of about 90 cts. per cubic yard. In Kansas City, Missouri, all old brick not suitable for use as a backing for building walls, were crushed along with all concrete from the old pavement base, screened, and used in a mixture of 1:3:6 concrete for a new foundation. This saved pavement base was not only practicable, but very desirable where prices of new material were high.

Protect Pavements from Damage by Car Tracks

We should not only practice greatest economy consistent with safety on the design and construction of our new pavements, but also with a view of protecting them from damage by poorly laid street car tracks. Nearly every city has more than one good example of the destruction of the pavement in and along car tracks by the improper ballasting of the tracks or by the use of faulty methods of construction in laying them. While it may



CONSTRUCTING NEW BRICK SURFACE ON OLD BRICK PAVEMENT ON WASHINGTON AVE., DANVILLE, ILL.
Top Row—Left: Old Lower Course Brick Ready for Concrete. Right: Spreading a Smoothing Layer of Concrete Over Old Base.
Lower Row: Spreading Sand Cushion—The New Surface Before Filling.

hauling the old material a considerable distance to a dump and saved the purchasing of new broken stone and it was estimated that the cost of the new concrete base was at least 25 per cent. less than it would have been if new material had been used. It was expected to find that this produced a weaker concrete than where new material was used, but a long series of tests of 8 x 15-in. concrete cylinders made from concrete going into the work showed that the crushing strength of the concrete, using old material free from fine particles, was practically equal to that of concrete of the same mixture using freshly broken stone. In Omaha, Nebraska, where some similar work was done, the brick were crushed at a cost of 65c per ton, including all overhead and depreciation charges. In all of these cases where such work was done, it was the general opinion that very durable concrete was obtained by such methods and that the use of the old brick in the new not be more than just in many instances to allow the tracks to go to the bad, it is not fair to allow such tracks to ruin the paving of the streets on each side of them. We have, therefore, adopted in Danville, the use of concrete sub-curb built integral with the concrete base of the pavement on each side of the car tracks and extending downwards a depth of 9 ins.—sufficient to get below the ordinary gravel or stone ballast used and thus protect the pavement at the side from damage. The concrete base of the pavement between the car tracks and along each side of tracks is separated from the base of the street proper by a thin separation joint, while the space between the brick surface and the concrete base in and to the side of the tracks is filled with a cement sand cushion proportioned about 1 to 7. This serves to prevent this cushion from shifting after the pavement has been constructed, and also its use for a distance each side of the rail pre-

REMOVING TOP COURSE OF BRICK ON WASHINGTON AVE., DANVILLE, ILL.—BASE READY FOR CONCRETE ON SAME JOB.

vents the possible shifting and loss of the sand cushion under the street pavement. The cost of this method of construction is very little compared to the advantages gained by having this in use. If the car track does cause destruction, it will only destroy the pavement in and along the car track and will not affect the portion paid for by the taxpayers, thus fixing the blame for and confining the damage where it belongs.

Conclusion

Pavement construction has passed through one experiment after another since the introduction of the old flexible base brick pavement years ago. With the increased use of cement, concrete foundations and cement fillers became popular. Now considering the high price of cement and other roadbuilding material and benefitting by the years of experience with these various types of pavements, we are coming back to the old practice—flexibility rather than rigidity in pavements. We must not act thoughtlessly, however, in the designing of our new streets. There are many questions to be settled before we approve such a pavement. True it is that many of our old streets have lasted longer and have given better service than some of the new but *would they* if they were subjected to our present day heavy traffic? Are we saving enough by their use to warrant it? Can we not put more money in sub-drainage and cut down our paving cost to a greater degree thereby? Are not rigid pavements best for heavy traffic? All of these are vital questions and must be satisfactorily answered before we adopt flexibility as our motto. We have made radical changes before—hence such are not impossible again. "Look before you leap" has been an oft' repeated motto that is peculiarly applicable here.

SOME ECONOMIC QUESTIONS AFFECTING HIGHWAYS

By J. E. Pennybacker, Secretary of the Asphalt Association, 15 Maiden Lane, New York, N. Y.

With 1920 forecasted as the greatest road-building year in American history and with the estimate of road revenues running to three-quarters of a billion dollars not including funds of cities and villages, economic problems assume greater importance than ever before. There must be no reaction through an orgy of spending simply because the money is in hand. Now, if ever, is the time for weighing carefully the economic justification of each highway project to ascertain whether it is worth the money and whether the design is appropriate. Some of our highways must cost forty and fifty thousand dollars a mile but they should "show cause" unmistakably.

Economic Highway Surveys

Time was when every dollar had to go to the primary purposes of giving us merely a place upon which man and beast and vehicle could find space to progress. In those days systematic study of the service possibilities of each highway and the establishment of a schedule and budget bulked too large as to initial cost. Today I believe each state could feature economic highway surveys as a preliminary to any considerable expenditure on highways, such survey to present comparative data on traffic, actual and potential; the service value of the highway to the communities for protection, educational progress, and pleasure travel; the salvage value of improvements already made; the possibilities of keeping money circulating locally by utilizing local materials and local industry; the comparison of the tax burden for interest, retirement, maintenance and renewal with the use to be made of the highway. In short, we are now spending enough to justify preliminary tests which formerly would have seemed costly and elaborate.

Highway Design

Highway design now is of most far-reaching concern, not only as it affects cost of construction, but also in its relation to the motor vehicle. Government tests have been referred to as showing the tremendously destructive possibilities of impact of heavy trucks. Thus it has been stated that a weight of 7,750 lbs. on a truck wheel with a speed of 15 miles may be equivalent to a static load of 43,000 lbs. if the wheel has a drop of 1 ins. Are we to design slab types of pavement to hold up a 43,000-lb. load? If so, even America's purse will not foot the bill.

Resilient Foundations

Just now stress is laid upon the possible "cushioning" effect of asphaltic surfaces with a view to "absorbing" the shock rather than transmitting it to the base. Other eminent authorities while not supporting the "cushion" theory say there is much to the claim that bituminous mixtures may have very great beam strength under suddenly applied loads—that is to say the impact. There are those who point to bituminous and water-bound macadam foun-

dations as distinctly superior to cement-concrete foundations and so general is this disposition to regard the foundation question as still a wide open one that the American Road Builders' Association recently voted unanimously against reporting in favor of recommending one type of foundation for trunk roads. When it is considered how stupendous a sum is involved in this question of highway design does it not seem urgent to make available at once as many hundred thousand dollars as are necessary to reach sound conclusions quickly, instead of following abstract formulas based upon beam strength assumptions? The Federal Bureau of Public Roads should have many times its present facilities and funds to work out this problem of highway design.

Vehicle and Gasoline Conservation

Now what also of the vehicle and its conservation? Highway surfaces must affect the wear of tires and the annual tire bill is estimated at upwards of a billion dollars. Ten per cent. reduction in tire wear would capitalize a billion dollar highway program and leave plenty of funds for maintenance.

And what of our gasoline consumption? Eight million cars will burn up gas at a more rapid rate if tractive resistance of the highway surface is high than if it is low. How much can we reduce the gas bill by designing suitable highway surfaces? Much, undoubtedly. Shouldn't the automobile industry be concerned in getting the public and the officials of the states and national governments to co-operate in such a study?

Co-ordination

The economic necessity for co-ordinating state systems of highways by a more effective national policy will bulk larger in 1920 because the need will grow more pronounced.

Fitting the parts of the road-building machine—the car supply; the manufactured product supply; the contractor and labor supply; the engineering supply; will put many a strain and jar upon the whole fabric, for never was it called upon for an effort comparable to that of this year. Why not a clearance committee of state officials to help this co-ordination instead of each state battling each other state?

Treatment of roadsides and questions of right of way, as time goes on, increasingly affect the economic value of the public highway. Roadside treatment does not involve merely beautification by the planting of trees and shrubs, but the much larger questions of protecting the highway itself through the planting of slopes to prevent slipping, the planting of trees and shrubs to prevent erosion and the protection of the highways against adverse weather conditions, this requiring in some cases planting and in other places thinning. It involves, with the enormous increase of motor traffic, some very positive measures for the protection of life through giving clear vision at dangerous curves and crossings; the prevention of encroachment upon right of way by structure, vegetation or sign boards. With a little breathing spell from the tremendous drive for construction records much needed attention to the economics as well as the esthetics of roadside treatment will be given.

There is sounding a continuous call for wider highway surfaces to meet the dense and fast-moving traffic. Wider surfaces cannot be had in most cases without wider rights of way. Property is increasing in value all the time and every year it costs more to secure additional rights of way. This question then assumes a very important economic status, for certainly if more space must be had the sooner we obtain it and the lower we can keep the initial cost, the better business it is, and if we can protect traffic by giving it more room in which to operate we are rendering a service which cannot be over-estimated.

Signposting Highways

Now that highway traffic is crossing and recrossing state lines to such an extent as to make the interstate traffic as great in many cases as the intra-state traffic, common sense dictates the necessity for an interstate agreement among our highway managers to so sign-post and mark the highways as to have the same symbols, the same colors and the same general design apply with equal force in all states. It is an unnecessary bit of confusion for the traveler to find that a series of red, white and blue bands on telegraph poles means in one state a particular memorial highway and in another state may simply mean direction. It is confusing and even dangerous for him to encounter advertising signs so designed as to simulate danger signs when the purpose is primarily advertising and the danger is remote. Many states have made great progress in sign-posting and marking their highways, while organizations have done much along national lines, but there remains the necessity for the official adoption of a national or interstate system, by concurrence of the appropriate state representatives. Nineteen-Twenty would be a suitable year to bring this about.

Federal Aid Policy

Congressional appropriations for Federal Aid have been made to cover the period up to and including the fiscal year beginning July 1, 1920. Either Federal Aid on its present basis is sound, or it is not. One thing is established and that is the conviction in the minds of the American people that the Federal Government should continue to be an active participant in highway work. The year 1920 should thresh out pretty thoroughly the economic merits and demerits of the present Federal policy and Congress should reach the point of at least initiating a broad policy in 1920 to become effective in 1921 as a successor to the Federal Aid Road Act. The question of a national highway system versus the Federal Aid plan is too important to be left to snap judgment and there is time if action is taken now for Congress to have before it next winter an exhaustive and comprehensive report by a competent board of engineers and economists as to what should be the appropriate Federal policy for 1921. Should not the creation of such an investigating board be one of the economic provisions of 1920?

All of these problems will be solved in due time, but let us consider them as today's problems and not wait until we "have time."

PROPOSED SCHEDULE OF SALARIES FOR ENGINEERS IN STATE HIGHWAY SERVICE

By A. N. Johnson, Chairman of Committee of American Association of Engineers on Salaries of Engineers in Public Service.

(Editor's Note:—The proposed schedule of salaries for engineers in state highway service was published in

full in the November issue of Municipal and County Engineering and attracted much favorable attention. The present paper by Mr. Johnson was presented at the recent annual convention of the American Association of State Highway Officials. The Association just named passed a resolution approving the proposed schedule. The other members of the Committee of the American Association of Engineers on the Salaries of Engineers in Public Service are: S. C. Hadden, Editor of Municipal and County Engineering; H. G. Shirley, Secretary Highway Industries Association, Washington, D. C.; J. H. Prior, Consulting Engineer on Public Utilities, Chicago; A. R. Hirst, State Highway Engineer of Wisconsin, and F. H. Newell, President of the Association).

The salaries of engineers in state highway service as proposed by the Committee of the American Association of Engineers on Salaries of Engineers in Public Service have been sensed as the result of observation and judgment rather than the result of any precise mathematical investigation.

Basis of Salaries Recommended

The basis upon which the list was built is, briefly, as follows: First, there were established salaries for three places in the schedule, the highest, a middle position and the lowest.

The highest position, that of chief engineer of a state highway department, it was felt should command in many cases fully as much as paid to chief engineers of railroads, and in fact should command more than chief engineers of other than some of the largest railroad systems.

The middle position was considered to be one requiring an engineer having at least four or five years' experience since graduation from college; a man who it may be expected will be married. Such a position should, therefore, carry with it such a salary as to enable a young engineer with a small family to live in comfortable and appropriate surroundings.

This point in the scale is perhaps more difficult to arrive at than either the highest or the lowest position, but in general it is the sense of the committee that such a position should receive not less than $3,600.

The lowest position was taken as one to be filled by a young man just out of college with the reasonable expectation of a raise in his salary at the end of six months. Such a position it was thought should command a salary not less than $1,200 to $1,500 per year.

The three points thus established are: highest, $8,000 to $15,000, the middle, $3,600 to $5,000, and the lowest, $1,200 to $1,500. With these established the other positions readily fall into line.

An examination of the salaries will show that it is expected that engineers will be gradually increased. Among assistant engineers it is expected there will be employed engineers having from 3 to 5 or 6 years' experience, thus the range of salaries in such positions is made from $2,400 to $4,000. All first assistant engineers, it is assumed, would be men of sufficient experience as to require the minimum for the middle position, that is, $3,600, with the range of $3,600 to $5,000.

The inspection service has been made a group by itself. This was done purposely by the committee to give emphasis to the importance of this service and to call special attention that such positions should not be filled by inexperienced men. The young man just out of college is not competent to serve as an inspector. It is assumed and it will be noted from the salary schedule where the inspectors of construction are rated $2,400 to $3,600, that these positions should command college men with not less than two or three years' experience or men of practical experience competent to be foremen.

In all positions commanding over $3,600 a year, the test as to what additional salary is to be paid is based upon the relative degree of administrative and executive responsibility the different positions involve. The general division of the positions indicates this basic classification. Thus, there is first shown what are considered as peculiarly administrative and executive positions calling for men possessed not only of technical skill but of practical experience, combined with administrative and executive ability. The individual engineer not possessing such attainments cannot expect to command the salaries attached to positions requiring such ability.

Application of the Schedule

This list of recommendations in regard to salaries of engineers in state highway service should be examined, not as an outline for an organization that is required or necessary in each state, but rather as a list of positions with corresponding salaries, from which may be selected a sufficient number of units to make as complete an organization as will be required by any state highway department. In order to do this, it was necessary, or seemed advisable, to enumerate a number of positions which would appear to be identical, so that it would be the easier for any department to fix readily the salary of any position in the department in accordance with the recommendations made by the schedule.

Thus the department which has a comparatively small amount of work and requires therefore a relatively smaller organization will find many positions listed, particularly among the administrative positions, that will not be required; and in such instances probably would pass immediately from the position of state engineer to those listed as first assistant engineers.

Universal Features of Schedule

There is no state having a state highway department where the state highway engineer cannot render a service to the people of that state worth at least $8,000 a year. It is also true that a rodman, whether working with the smallest or the largest organization, is individually worth as much in the one class as the other. The difference lies merely in the fact that there are more rodmen connected with the larger organizations than with the smaller. Similarly, the individual inspector, whether connected with the small or large organization, can inspect properly only so much work and is worth as much in the one case as the other; again the difference being merely in the number of inspectors to be employed. The number of inspectors and the number of rodmen will in turn determine the number of men required for the higher positions. Thus, when examined in this light, the salaries as here proposed apply with equal force to the largest as well as the smallest state highway organization.

The only difference would perhaps lie in the application to be made of the range of salaries in the lower positions and in the higher positions. In the lower positions the range shown in the salaries is to be interpreted to indicate the opportunity for promotion in the positions named, whereas in the administrative positions the range in salary is to be interpreted more to differentiate between larger and smaller organizations for which the positions are considered. That is, it is assumed the larger organizations impose a greater responsibility and therefore the chief engineer should command a higher salary than in the instance of a smaller department.

Schedule Given Publicity

In order that the committee might have the fullest information from which to prepare its report, the list of salaries for engineers in the state highway service has been circulated widely, particularly among all the state highway departments, has been published in a number of technical and trade papers and criticisms invited from every source. In general, the criticisms made have been favorable and the schedule approved.

In a few instances critics have suggested changes. In particular the salary attached to engineer of bridges, recommended to be from $5,000 to $8,000, has been criticised by a number of bridge engineers as discriminating against this position, which it is contended should carry a salary that would indicate the position to be of equal importance with that of the engineer of construction or engineer of maintenance. The committee gave this criticism careful study and, after consulting with a number of chief engineers of different state highway departments, was of the opinion it would not be warranted in making the change suggested.

Short Sighted Criticism

If practical results are to follow suggestions of the American Association of Engineers regarding salaries of engineers in public service or in any other service, the first essential is unity of opinion and purpose amongst engineers themselves. One of the chief drawbacks to higher salaries for engineers in public service has been in the past the opposition of these very engineers themselves. This may seem at first paradoxical but here is an instance: A legislative committee gives a hearing on the subject of salary increases for a certain position and behold there appears before the committee a number of engineers who state that even lower salaries than those paid at present are paid to many engineers and that engineers may be easily secured for the present salaries. What is a legislative committee to think? The engineers who make such statements do so usually from jealousy. It is frequently some engineer who has been disappointed in securing an appointment and cannot see that what is for his brother's welfare will be the most powerful argument and means to increase his own income.

That engineers may be united and present no conflicting testimony and make no contradictory claims is one of the purposes of the American Association of Engineers. I hope you will urge your associates to join the Association and become a real factor not alone to help yourselves but to do so by helping others.

The basic idea and purpose of the schedule is to secure a salary for the man who selects a career in highway engineering that will reasonably assure him, under present conditions, an opportunity to support and educate his family in a modest way. As we reach those positions that demand a wide experience and special accomplishments which make the engineer of judgment and administrative ability, the salary to be paid should represent the value of the service rendered to the public and be commensurate with the responsibilities imposed.

THE CONSTRUCTION OF ASPHALTIC ROADS IN THE PANAMA CANAL ZONE

With that foresight and broad comprehension which characterizes the success of all development, the United States Government is enhancing the commercial value and prestige of the Panama Canal Zone in a thorough, methodical manner. Beautification of the various communities, the erection of comfortable and attractive dwellings, and the construction of modern, durable highways forms part of the program which is intended to put the Canal Zone in a position of commercial and industrial prominence, to make it a veritable hive of pulsating activity, and to offer it as a place where ambitious men can achieve success and prosperity.

The importance of the Panama Canal has been recounted extensively, and all persons are cognizant of its inestimable value to the United States. As the gateway between the Atlantic and the Pacific, it is one of the bulwarks of American maritime commerce; it has given stimulus to this country's trade and prosperity, and it stands as a monument to the Government's ability for achievement. In close association with the Canal itself is the development of the Zone which is under the government of this country, and the plans for this development have been worked out with the same wise, careful foresight that led to the accomplishment of the waterway itself.

FIG. 1. SHEET ASPHALT WEARING SURFACE LAID ON A CONCRETE BASE ON THE HIGHWAY THROUGH PEDRO MIGUEL, PANAMA CANAL ZONE.

Perhaps no phase of the development of the Canal Zone has been given more attention than the all-important matter of highways. Realizing the close inter-relation of good roads and prosperous advancement, the Department of Operation and Maintenance has laid out a broad, comprehensive system of highways, which not only provides excellent streets of durable type in the cities and

towns, but also provides lasting roads between one community and another. The military posts and quartermaster stations, too, are surrounded by roads which will stand up under the terrific wear and tear of the numerous automobile trucks which furnish one of the most used means of transportation in the Canal Zone. It has been considered all-important, furthermore, to provide connecting links between the various communities so that automotive traffic will not only be encouraged, but so that the inhabitants will get the domestic advantages and comforts of rapid delivery of foodstuffs and other commodities.

Sheet asphalt and asphaltic concrete streets and highways have been built in the towns and on the main links between communities. The construction of these arteries

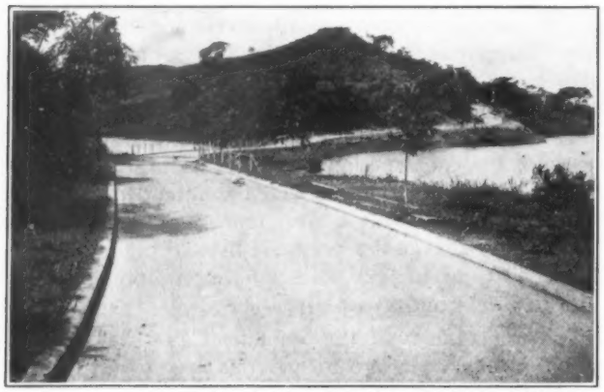


FIG. 2. A SECTION OF THE ANCON-PEDRO MIGUEL HIGHWAY: CONCRETE BASE, SHEET ASPHALT WEARING SURFACE.

of traffic was done not by private contractors, but by government forces under government direction. The thickness of the asphalt wearing surface was 2 ins., laid on concrete foundation of 6 ins. thickness, with one quarter of an inch to the foot as a crown. The concrete curb and gutters were poured as part of the slab.

One of the economic features of this highway construction is the fact that native sand is available to be mixed with the asphalt. This obviates the necessity of paying freight rates and haulage charges, and results in economical construction. During last season large yardages of Texaco asphalt were laid at Pedro Miguel and on the Ancon-Pedro-Miguel-Miraflores Road.

THE DESIGN OF MODERN ROAD SURFACES, WITH ESPECIAL REFERENCE TO ALIGNMENT, GRADE, WIDTH AND THICKNESS

By Charles M. Upham, Chief Engineer, State Highway Department, Dover, Delaware.

In the consideration of practices influencing the design of modern road surfaces, with especial reference to alignment, grade, width and thickness, this article will deal with generalities, and will not consider specific cases, for it is evident that it would be impossible to recommend any definite method or practice, within narrow limitations, at least, that would satisfy all conditions, as they vary throughout the entire country.

Rules to Follow

When the problem of the design of highways is taken into consideration, there are several rules that can be followed and accepted as the best practice; these rules are the result of years of experiment and trial; and if followed will assure ideal results and conditions; but in every locality, there will be varying conditions and local influences, which will make it impossible to follow consistently these fundamental rules of road design.

General Considerations

Almost the first step in the design of a highway, is the study of its location; keeping in mind the purpose

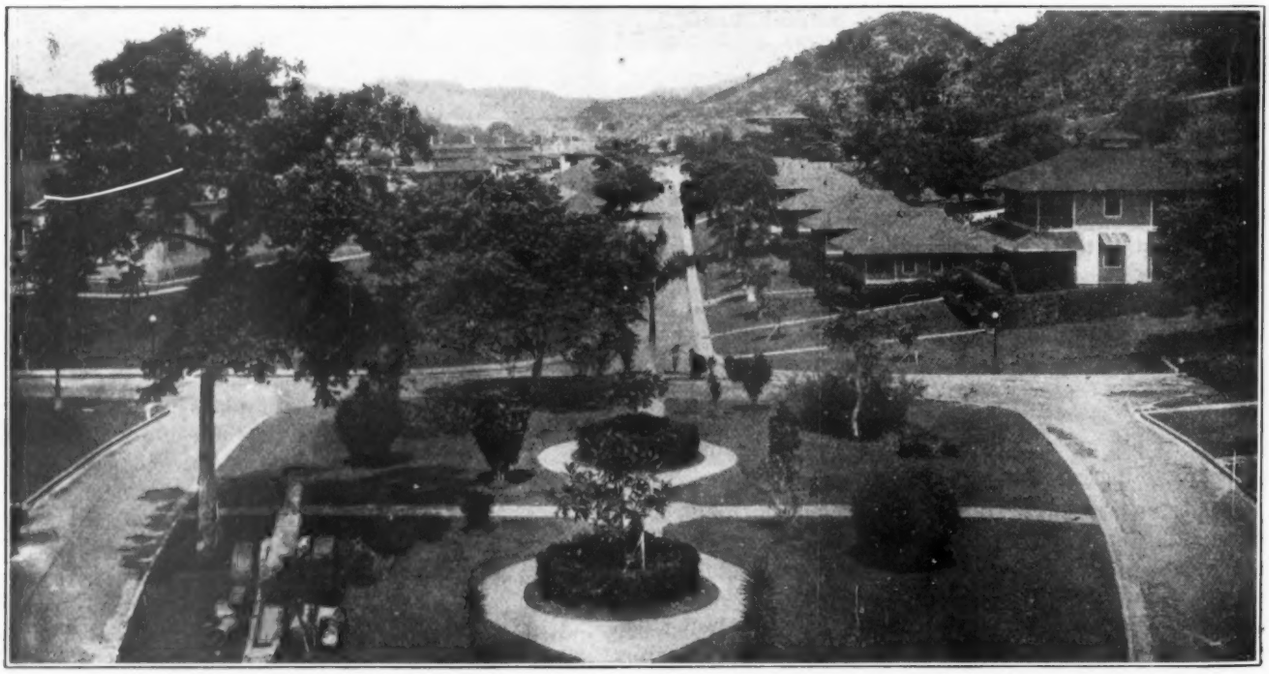


FIG. 3. MAIN STREET, PEDRO MIGUEL, PANAMA CANAL ZONE, ASPHALTIC CONCRETE PAVEMENT.

which the particular highway is to serve. If the highway is constructed as a scenic road, then the problem is well defined, but if the highway is to serve as a lane for commercial and industrial traffic, then the problem becomes more complicated and careful study is necessary in considering the question of how local traffic can best be served without lengthening thedistance, and introducing curvature. At the same time, the question of grade must be considered in connection with the alignment. The ruling and intermediate grades kept within an economic per cent.; the total cost of grading should also be considered. The location of road revolves itself into the problem of economic compromise, depending on the solution of these factors.

There are a few localities where ideal alignment and grades can be secured, but in most places local conditions and limited topography make it impossible to attempt this ideal alignment, but still the inclination to lean towards the ideal alignment should always exist, though it be impossible to attain it completely.

There are more variables affecting the problem of width of roadway than in the choice of alignment and grade. The width of highways should be dependent upon the alignment and grade, as well as upon the amount and character of traffic, and the character of the roadside.

Economic Thickness

In considering the thickness of the pavement, there are several features that must be taken into consideration before a final decision can be made. With unlimited funds, it would be a simple problem to select a thickness of pavement that would carry all traffic, but the problem is to design the economic thickness, a pavement that will carry the load without any surplus thickness beyond a reasonable factor of safety. Of course the thickness of a given type of pavement is dependent upon the character, number, and weight of the vehicles that it must carry, as well as the character of the soil in the subgrade, and the possibility of keeping it completely and quickly drained.

Prevailing Practice

In order to keep the consideration of the above subject general, and in order to form a nucleus about which recommendations and practice could be discussed, I took the liberty of writing to several state highway departments, located in different sections of the country, and asked their practice in the design of roads with reference to line, grade and thickness. The replies show that on alignment and grade, most of the states were traveling along the same general direction; some approaching nearer than others to the ideal condition. When the question of widths was taken into consideration, it was noticed that in those states, in which were located the largest number of cities, and where traffic had become excessive, and the demands for more room had been felt, wide pavements were being constructed.

A uniform thickness of pavements seems to have been followed by all the states, with the exception of those in which were located cantonments. In these particular cases, a greater thickness of pavement has been adopted.

Alignment

In giving consideration to alignment, roads may be divided into two classes; the one, being roads located within parks, and intended as scenic roads and used mainly by sight-seers and tourists; the other being roads that can be considered as commercial or industrial roads, which would be located within and between business centers, towns, cities, etc.

In the alignment of the park or scenic roads, it is not essential to have long tangents nor direct routes; the only essential requirements of these roads, are that they shall furnish lanes of travel for pleasure riders, and shall be properly designed and constructed from the standpoint of safety and beauty. These roads need not be laid off in direct routes, because speed or time is not generally an element to the users of these highways.

The controlling points of the scenic road are entirely different from the industrial road, and consideration should be given beautiful views; preserving of trees; the regard to costly residences, and in fact, any detail that may serve the purpose of making the road more beautiful. With the controlling points fixed, the only other consideration is that of safety and the expense of construction.

There seems to be a practice among practically all the states, that from the standpoint of safety, the alignment of the scenic roads should be such, that the radius of all curves should not be less than 300 ft.; though in many instances it is common practice to use radii of 200 ft. or less.

The commercial road may be described as that road that will most economically serve the commercial or industrial requirements, or defined in another way, may be called the direct route.

In considering the alignment of commercial roads, or direct routes, it must always be remembered that a straight line is the shortest distance between two points, and from a commercial standpoint, the shortest way is not only the most direct, but with other things equal, is the most economical; therefore, it seems to be practically conceded that ideally aligned commercial roads are those that are laid in absolutely straight lines.

Where there are costly influences entering the problem that make it impossible or impracticable to follow the straight line, then the alignment should approach the straight line, and become a compromise of line, grade, and cost of construction.

By the straight line method it does not mean, that two distinct points should be given ultimate consideration, but each and every community and business district lying between these points should be given due regard, and the line should run in the most direct line possible connecting up these intermediate controlling points, provided the line will form a direct route.

More stress has been laid upon the alignment of roads during the past two or three years than ever before. It simply shows that highways are passing through the same stage that the railroads passed through when after exhaustive studies from an economic standpoint, they spent considerable money for the straightening of their lines. The problem of the highway is practically identical with that of the railroad. Much study should be given to final location, for after all, the location of a road is the only permanent detail; therefore, this should approach the ideal as closely as possible.

In the construction of hard surfaced roads, the alignment is well defined, and very little change or slight angle can be plainly seen. If breaks in the line are necessary they should be located on the tops of hills or summits in the grade.

If necessary to use a curve, then the flatter the curve, the safer the road, and this would not jeopardize the beauty or purpose of the road in any way.

When a curve sharper than 4 degrees, or of 1433 ft. radius, is used, the roadway should be elevated on the outer side, and widened on the inner side. This will overcome the tendency of the traffic to skid and make driving both safer and more pleasant.

A very important feature in deciding the alignment of roads, is the consideration to the through traffic. The ideal road is one that will serve through traffic by direct routes and also make it possible that this traffic need not be delayed on account of congested districts. In other words, the best alignment for a through traffic road, is a straight line so located as to pass near, but not pass directly through these congested districts. With such a location, the through traffic is not subjected to interference or delay which is always present in the main thoroughfares of towns and villages, nor on the other hand is the town or congested district subjected to the hazard of the through traffic. By such a location the congested districts have all the benefits of a modern highway, but are not subjected to its disadavantages. Therefore, when considering alignment, this is a very important detail to keep in mind.

Under alignment, there may also be mentioned the subject of the width of right of way. This we find in nearly every state has been neglected or it has given considerable trouble, when road developments have been carried on in a modern way. Until recently only in a few states were right of ways obtained wider than 40 ft., or was there any amount of effort made for direct routes or straight lines.

With roadway sufficiently wide to take the amount of traffic and to add to this such space as is generally necessary for shoulders and drainage, a minimum right of way of 60 ft. should be obtained in districts outside of cities and towns, especially if the country is at all rolling.

When the smaller towns are approached or entered, the right of way of sufficient width to allow for the widening of the roadway to take the additional traffic, should be obtained, as well as sufficient width for the carrying into effect of any beautification scheme, such as grass plots, flower gardens, tree planting, etc., that might be developed at any time in the future.

In the case of cities, it is quite advisable in the construction of any road to secure, as soon as possible, sufficient width of right of way to provide for future development, such as might include wide sidewalks, grass plots, areas for tree planting, besides sufficient roadway to take care of the ultimate traffic.

It may possibly be said that through many villages and small cities it would not be practical to secure such width of right of way as recommended, especially after developments in property have been made.

This might be true if it was necessary to bring around this condition immediately, but this could be provided for ultimately by establishing new building lines or property lines, making it compulsory that all future developments and re-building should be a certain distance from the road. In this way, a wider right of way would finally result, with the expense of an immediate change.

It may be said that a highway, as a factor in transportation, is no more economic or efficient than its ruling grade.

Grades

Grades and alignment seem to be so closely related, that many times one is dependent on the other, or one is bettered at the expense of the other. In any case, the ideal conditions should always be kept in mind, and a compromise wherein the maximum of an ideal condition should result.

The same general division can be made with regard to the choice of grade as to line, namely; scenic roads and commercial roads. On the scenic roads, safety and beauty seem to be the controlling factors, while on commercial roads, the problem is an economic one, and the requirement is that traffic should use the road at a least cost or effort.

In designing the grades for highways, there seems to be a general tendency for the states to make an effort to limit the maximum or ruling grade to 6 per cent., with the possible exception of short stretches, which seem to be allowed in most states. This 6 per cent. grade was established in the days of horse drawn vehicles, and while it has served in that purpose, it has not been definitely established at least that this is the most economic grade for motor vehicles. A maximum or ruling grade for motor vehicles is the steepest grade that can be negotiated with minimum of power. This problem is now being studied but it can only be determined after careful study and experiment and close co-operation with the motor industry.

In most states it is impracticable and almost impossible to hold to a grade as low as 6 per cent. and in these cases, if a grade considerably in excess of 6 per cent. seems necessary, a study of relocation should be thoroughly made with an end in view of reducing the grade. It is economic to increase the length of line if a reduction of grade will result.

At the beginning and end of all grades, vertical curves should be used in order that the grades shall preserve a continuity and can be approached gradually, as well as provide a long line of vision. There is one definite conclusion, however, that we can draw relative to grade; the power to negotiate the grade increases proportionately to the per cent. of grade. With this law established, we can see that the level grade would be the ideal grade from an economic standpoint. With this definite law, the problem of grade is somewhat simplified and can be determined. In many cases, more power is absorbed in overcoming the surface resistance than in overcoming the grade.

It was often thought, that before a grade or hill was improved it was the grade that was causing the resistance, when as a matter of fact the road surface probably caused many times more resistance than the grade. With an unimproved surface the grade resistance is a small percentage of the whole resistance; with an improved road, the grade resistance forms a much larger percentage

of the whole, showing the necessity and economy of reducing grades, if we wish to retain the advantage when hard surfaces are constructed.

After establishing the level grades, as the ideal economic grade, all efforts should be made to approach this grade in the design and any compromise with line or expense of construction should be made with the ideal grade in mind.

Widths

While the requirements of widths of pavement can be divided into demands for scenic widths and commercial road widths, the demands and requirements are so closely associated that only commercial roads need be considered.

While the width of pavement can be said almost wholly to depend upon the character and amount of traffic, the problem still remains far from being solved on account of its being affected by the variable known as the personal equation; something impossible to solve.

The worst condition that generally exists on a road is when wide trucks are placed side by side. The average width of the wide truck is 8 ft., so it can be seen that two trucks would theoretically just take up the entire space above a 16-ft. road. Practically, however, due to the overhang over the wheels, these trucks might be placed on the pavement so there would be a 2-ft. clearing between the bodies, provided each truck went to the extreme edge of the pavement in passing. This, however, is not often the case, due to the fear of getting too close to the edge of the roadway, and the condition of the shoulder being too uncertain. For this reason it can readily be seen why most states have already relegated to history, the 16-ft. roadway, and stepped forth to 18 or 20 ft. for a double track road.

For a two-track roadway, nearly all states are now advocating 18 ft. with a minimum shoulder on each side, 3 ft. in width. A few of the states still adhere to a roadway of 16 ft., but in this case, shoulders are always provided whereby the traffic may readily ride on the shoulders, provided it is necessary.

In a three-traffic road, many states adhere to the 24 ft. in width, but there seems to be a growing tendency that this should be increased to 26 or even 30 ft.

The reports of the American Road Builders' Association, covering this subject of widths, recommend that a double traffic trunk highway should be at least 20 ft. wide with a minimum shoulder of 5 ft. Wherever there is an additional line of traffic, 9 ft. should be added to the roadway. Wherever the right of way can be acquired, provision shall be made for shoulders of at least 9 ft. in every case. This is for the purpose of future widening of the roadway when necessary.

To widen a roadway to certain limits is a step in the ideal direction, but it cannot be said that a roadway should be widened without limit, for after a certain width is reached, and traffic becomes heavy, lanes for traffic should be established, and furthermore, separate lanes for the fast traffic, as well as the heavier or slower traffic should be set up.

The cost of road enters strongly into the determination of width, and when the compromise is made, the minimum should be sufficiently wide to take care of the lines of ordinary traffic, plus as much clearance width as the importance of the road and the intensity of the traffic justifies.

Regardless of width of roadway, the shoulders should be maintained in a serviceable condition for cases of emergency. If the roadway is not sufficiently wide to provide for traffic, the shoulder will receive considerable of this traffic, and cause excessive maintenance. Many times this excessive maintenance would pay the cost of construction of a wider roadway, which would result in a much lower shoulder maintenance and provide a more satisfactory pavement.

In level countries where alignment is straight and the curve flat, there seems to be no necessity for an increase in width from the general widths required for the various number of lines of traffic, but in countries where the alignment is not straight, it is quite essential that the width on all curves of 10 degrees and over should be materially increased.

The width of increase on pavement should take place on the inside of the curve and begin at a point outside of the point of curvature and extend beyond the point of tangency. The additional width varies according to the degree of curve and local conditions.

Many states have after deciding upon their unit of width made their width of road entirely dependent upon the amount of traffic. Where the traffic is up to 3,000 or 4,000 vehicles a day, the roadway is not less than 18 ft. in width; where the traffic averages about 5,000 vehicles and over during the day, the roadway is made at least 26 ft., and sometimes 28 or 30 ft. In this instance satisfactory shoulders should be provided for the chance or accident that the traffic is forced off the metal roadway on to the shoulders.

Some states have decided that if a hard surfaced pavement is to be used, the minimum roadway, in order to provide for a single line of traffic should be at least 9 ft. in width and preferably 10 ft. A pavement of this kind should not be attempted unless there are satisfactory shoulders of sufficient width and character whereby vehicles can pass without danger, or, that turnouts should be provided at intervals.

Thickness

To make any specific recommendation as to the necessary thickness of this pavement would be attempting to solve a problem wherein there are two or more variables, for the thickness of a pavement not only depends upon the demand of traffic that this pavement may be subjected to, but also depends upon the type of pavement and the conditions of the subgrade and drainage system, which influence not only the strength of the pavement, but its resistance to withstand the numerous and varying loads. With the old pavements that were designed to withstand merely the demands of the lighter vehicles, practically all failures were due to the wear of the surface. As the loads upon this pavement were increased, the pavement broke down from the very fact of being unloaded, and it was not a case of the pavement wearing out. This would seem to indicate that a pavement of a strong compressive strength that will withstand heavy loads as well as hold up when the pavement is acting as a beam, is demanded.

Pavements are called upon to withstand compressive stresses, to resist stress, set up, when the pavement is subjected to beam action, or to resist shear stresses. It seems that most of our pavements have been so designed as to withstand the compressive and shear action, but the greatest trouble has been found in attempting to design a pavement that will withstand stresses when the loads bring about beam conditions. Of course it will be a simple matter to design a pavement that will act as a beam and withstand any load, provided it is not necessary to keep in mind the necessity of keeping the cost within moderate limits. In order to determine the thickness of pavement, considerable effort has been attempted in the way of distributing the weights or force over a large area.

Other experiments have been made using a cushion in attempting to overcome impact and produce resiliency.

Almost the first step in designing a pavement must be to assume the nature and condition of the subgrade; the better the subgrade, the thinner it is possible to make the pavement.

As the conditions of the subgrade become worse, the thickness of the pavement must be increased, so that on account of the changing conditions of the subgrade, our first assumption is full of variables. Generally the design is not changed for each condition of subgrade, but the worst place is considered and the entire pavement designed from these conditions; this, of course, is uneconomical.

The ideal limit would be to have a perfect subgrade. Then only a thin surface of road would be required. As the subgrade became worse in character, the thickness of the road surface must be increased for the purpose of distributing the loads over a wider area. A popular method of load distribution has been the use of a rigid base such as concrete.

While in many designs it is assumed that the stresses travel from the load to the subgrade in lines of 45 degrees to the surface, actual experiments show that in a concrete surface, the lines of stress reach as far as 6 ft. from the load application; this means that the load is sometimes distributed over a 12 ft. area.

Now the problem is to design the road to take care of compression; punching shear, and beam action. Taking into account the distribution of forces produced from the load application, either a concrete, or a concrete base pavement, surfaced with bituminous material, will overcome the compressive requirements, and the minimum of designs, supported by a satisfactory subgrade, has always cared for the punching shear.

It would seem that an economic pavement could be one of a material such as concrete and capable of distributing loads, laid on a carefully prepared subgrade, designed as previously described, and if this pavement should be subjected to excessive impact, it could be covered with a bituminous surface. This would mean a bituminous mat that would absorb impact and transfer the loading to the concrete which in turn would distribute the load over the prepared subgrade. Where the subgrade was prepared as described there would be a slight chance of its shifting, which would mean that the span between supports would be small, which would further mean that a much thinner concrete distributing layer could be used.

Conclusions

In order to crystallize the points of this article on line, grade, width and thickness, the conclusions of this paper may be drawn:

Alignment.—On scenic roads the straight line is not absolutely necessary but all importance should be laid on safety. On commercial roads the straight line is ideal and all roads should approach this alignment.

Grades.—While the grades on scenic roads should be held low wherever possible, the ideal grade on a commercial road is the level grade. Whenever a road surface is changed from earth or macadam to hard surface, the grade should be materially reduced if it is desired to retain the advantage of a hard surface.

Width.—The minimum width of a two-way traffic road should be at least 18 ft. and an additional width of 9 ft. added for each line of traffic; suitable shoulders should be provided in all cases. After a four or five-way traffic is reached, the roadway should not be increased, but lanes for the separate lines of traffic should be constructed. All curves sharper than 10 degrees should be widened and banked.

Thickness.—While thickness is dependent on type of pavement and nature of traffic, it is also closely identified with condition of subgrade. To better the subgrade, means the possiblity of reducing thickness of pavement, which seems to indicate it might be more economical to spend money preparing subgrade, than to attempt to support the loads by blindly increasing thickness.

The foregoing paper by Mr. Upham was presented at the recent annual convention of the American Association of State Highway Officials.

THE SMALL ENGINEERING JOB—A NEW CONCRETE FLOOR IN AN OLD BUILDING

By E. McCulloh, of the Charles L. Pillsbury Co., Metropolitan Life Bldg., Minneapolis, Minn.

The Small Engineering Job

Comparatively early in his career, the writer learned that while, with the wealth of descriptive matter available, it would be easy for him to equal or surpass such works as the Sweetwater Dam, or the Croton Aqueduct, when it came to designing or detailing the every day, average structure of moderate cost, especially with the inadequate funds generally available, in all the realm of engineering literature there was scarcely a word for his guidance.

After laying out a large proportion of the Pacific Slope in town lots, it fell to him to design and detail a number of short span bridges of the type known as "Combination Bridges," with steel tension and timber compression members.

Nothing was to be found in the books and similar existing structures were so evidently inadequate to carry probable loads and so poorly detailed that he was forced to evolve satisfactory plans and managed to produce his first crop of gray hairs at the same time. He confesses to a feeling of some pride that the resulting structures were

simple in detail, provided for all stresses, have been widely copied, and have stood the test of a quarter of a century's use and are still in good condition.

He has since learned that many, and probably the majority of the problems which present themselves to the average engineer, have to do with similar inconspicuous work and has come to believe that in producing good results with often insufficient funds, there is as much or more good engineering perpetrated as in the monumental and spectacular structures so fully covered by the technical press.

The writer's greatest troubles occurred more than twenty years ago and since that time, notably within the past five or six years, there has been quite a change and

It was a four story brick building with basement and sub-basement—the floors and interior columns being of timber.

On account of a fire about 1906, the two upper stories were rebuilt, but the lower stories, basement and sub-basement remained as originally constructed, except for some slight repairs, until August, 1919.

The building was generally "mill construction" but the posts of the basement story extended through the floor to 18 by 36 ins. limestone piers in the sub-basement. On these same piers rested 12x14-in. beams supporting the basement floor joists which were 3x14 ins., spaced 12 ins. on centers. Outside dimensions of the building are 58x140 ft. and there are two rows of nine posts each—the

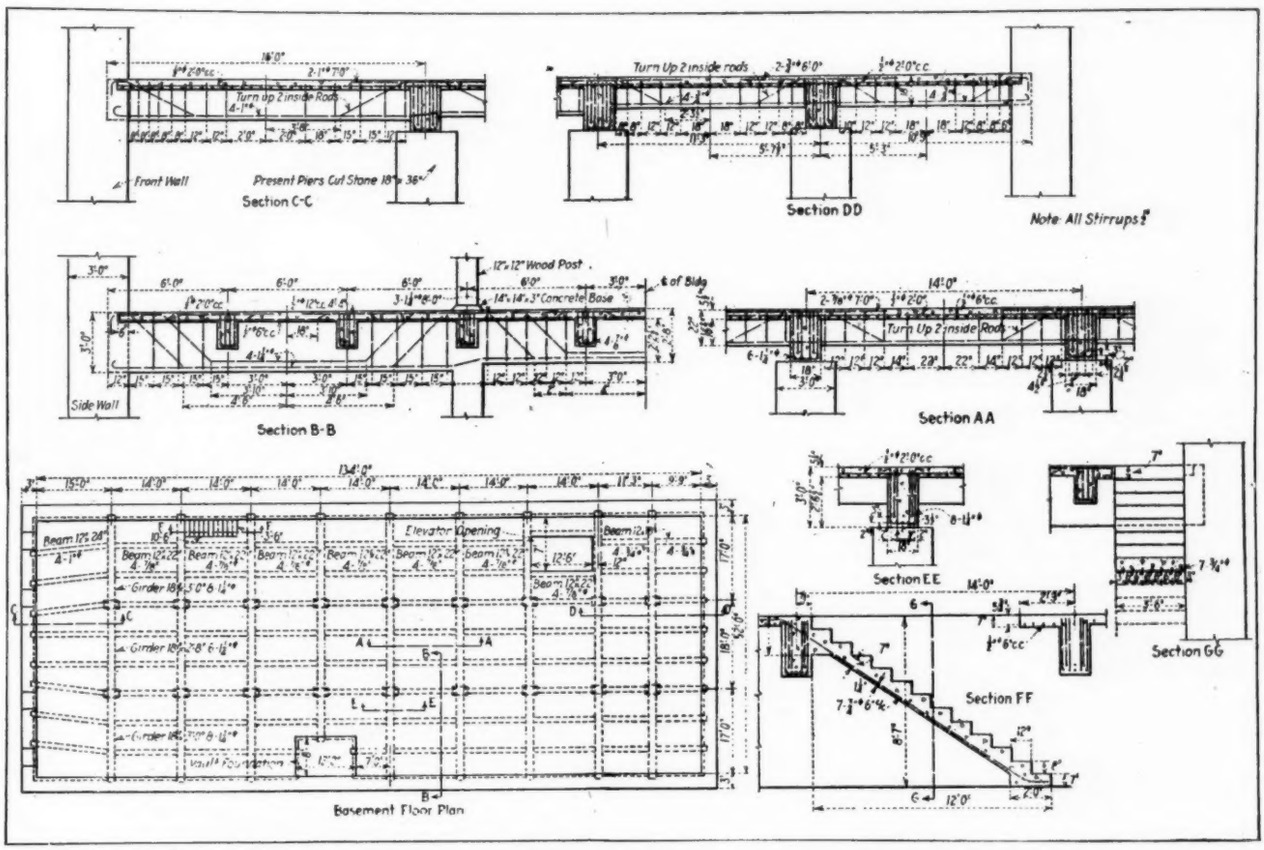


FIG. 1. GENERAL DRAWING SHOWING DETAILS OF A NEW CONCRETE FLOOR PLACED IN AN OLD MINNEAPOLIS BRICK AND TIMBER BUILDING.

today, engineering periodicals and text books contain articles having to do with all kinds of structures, methods of construction, improved details and all the matters of interest to the young engineer and to his older brother in current practice.

New Concrete Floor in an Old Building

In view of his early experience, the writer is impelled to give here, a description of one of the problems which recently presented itself to his office, its solution and the every day ingenious method which lead to its successful conclusion at reasonable cost.

Some twenty-five years ago, there was built in what was then the heart of the business district of Minneapolis, a general store building, and at that time, it must have loomed large.

span of the 12x14 in. beam except at ends, being 14 ft., and of joists, generally 18 ft.

The general arrangement of piers is shown on the Basement Floor Plan—Fig. 1.

In March, 1919, we received a communication from the agent in charge of the building, saying that they were troubled by water in the sub-basement, and while the sub-basement was not used, the tenants objected to the condition and feared it was causing decay as the building showed some settlement, and requested us to investigate and see what could be done to drain and ventilate and what repairs might be needed.

Investigation showed the sub-basement to be some five feet below the street sewer and that during storms, water ran under the floor and down the elevator shaft.

Also, that there was some seepage through the bare limestone stratum in the bottom of the sub-basement.

At the time of the first visit, there was about a foot of water in the sub-basement and it was reported that occasionally, after a rain, it rose to about two feet.

Waste lumber, wreckage of old floor and other debris was scattered and piled about to such an extent that close inspection was practically impossible. It was evident however, that the whole basement floor and a number of the posts were in very bad condition.

There was an old sump at one end of the sub-basement, directly over which was located the main sewer outlet from the building. The first step was the installation there of a No. 3 Pemberthy Cellar Drain, at an expense of slightly over one hundred dollars, after which, to the surprise of the agent and tenants, there was practically no further trouble with water in the cellar.

Old Structure Unsafe

Close inspection now showed a serious condition. Floor joists and beams alike, were rotted to an extent almost unbelievable, in view of the fact that the floor was still standing. Several of the beams were actually broken and apparently held up by the flooring. A number of the posts showed excessive rot below the basement floor line and had settled from 2 to 4 ins. A year or two ago, what the agent spoke of as some permanent repairs had been made by a contractor. A number of the posts had been reinforced (?) by bolting two 12-in. channels about 5 ft. long, to each; 8x8-in. posts on small concrete pedestals had been placed under the centers of a number of the floor beams and a few of the floor joists had been renewed.

The agent was advised to have a new floor built and such posts as showed decay renewed, and as the building was really in a critical condition, such repairs and renewal should be made without delay.

The foundation walls and piers were in excellent condition and plans for a reinforced concrete floor as shown in detail in Fig. 1, were prepared. However, notwithstanding the serious condition, the work was not finally authorized and contract entered into, until late in August, and in the meantime, the prices of labor and material had advanced to such an extent that the contract price was considerably in excess of the first estimate.

During the progress of the work, the tenants, agent and workmen were badly frightened, and the urgent recommendation for immediate repairs justified, as between Saturday night and Monday morning, a section of the building settled nearly three inches. This was not brought about by any operations of the contractor but occurred at a point in the building not yet approached by his work, and was the result of crushing the bearing ends of several of what appeared to be the most nearly sound of the posts.

Fig. 2 is a photograph of lower ends of three of these posts. The chunks on top are what remained of the oak bearing blocks, in relative position to the posts, after settlement, and show clearly the extent to which the posts crushed and settled. Surfaces of posts broke off and cracks formed as shown, when the settlement occurred.

In addition to construction of the concrete floor, the contract provided for jacking the building up to original level and supplying such new posts as might be required. It was found that all posts were badly decayed at the heart and it was necessary to renew them all.

Interesting Feature of the Work

It was assumed that it would be necessary to timber from the sub-basement through the basement floor to the first floor to accomplish this purpose, but the contractor evolved a method which avoided the necessity of doing so, and which was the interesting feature of the work, resulting in a saving of about two thousand dollars.

He, with the approval of the engineers, after removing the old floor, built around each post, as shown by Fig. 3, a sheet metal box, 14 ins. square with one side sloping an inch wider to the top. This slope was just sufficient to permit the posts to be tilted over subsequently and removed.

The ends of the girders and cross beams were enlarged as shown and the reinforcing bars bent over and passed outside the posts.

FIG. 2. VIEW OF DECAYED POSTS REMOVED FROM A MINNEAPOLIS BUILDING.

The floor was cast in three sections and at the time the first section was cast, 18 blocks were cast, 13 ins. square and a little over 3 ft. long to be used as pedestals for the new posts.

As soon as slab was well set, the upper floors at each post were jacked up, old post and sheet metal form removed, concrete block placed and grouted in, and new post put in place. Upper floors were supported and raised by four housemover's jacks at each post supported by 8x8 in. posts on sills resting directly on the new slab. The temporary supports were removed at the end of about 48 hours so that only three sets of posts and jacks were required.

The order of procedure was devised by Mr. Paul Pruffert of the contracting firm of Pike and Cook.

The cost of the work was very close to nine thousand dollars and the net result—a building practically permanent to the first story, good for many years to come, and of which the rental value has been practically doubled.

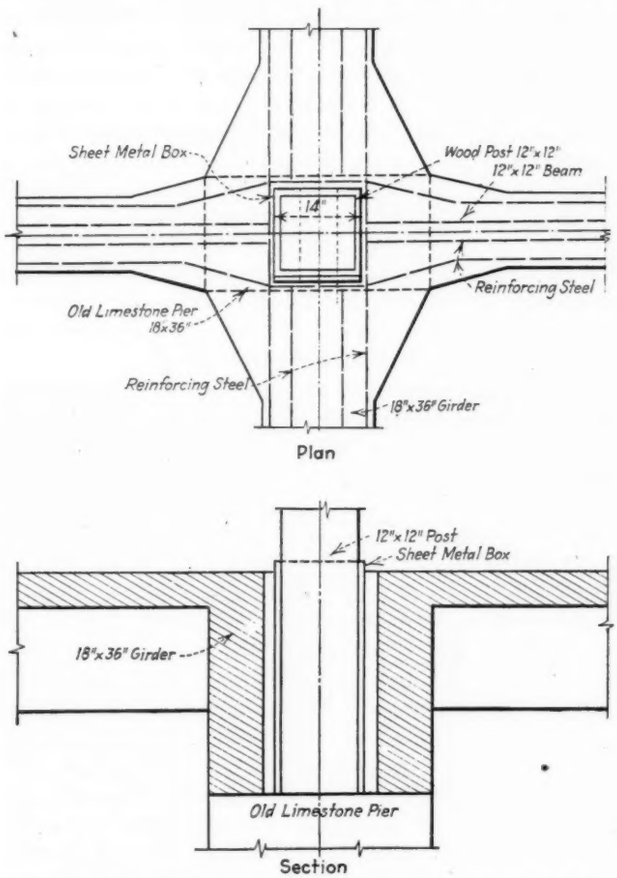


FIG. 3. METHOD EMPLOYED IN REMOVING AND RENEWING THE WOODEN POSTS.

It may be asked why a concrete floor should be placed in a building of this character. The building is used, and practically always has been used, as a wholesale hardware store. Estimates of an adequate timber floor at present prices, were considerably higher than for concrete.

USE OF EXPLOSIVES ON ROAD GRADING

By M. C. Potter, Bellevue, Iowa.

Road supervisors and county engineers in this locality are becoming convinced that it pays to blast down high banks along highways with dynamite in preference to employing old style pick and shovel methods or rooters drawn by teams.

In most all cases, stumps are encountered on top of the banks and gravel or small boulders, are interspersed through them. The boulders and the roots make it difficult and often impossible for the teams to pull the rooters and the breaking of machinery or harness and the injury of the horses is of frequent occurrence.

We have found that by putting down holes vertically in the top of the banks, locating them 3 to 5 ft. back from the face and loading them with a few cartridges of dynamite, the size of the charge depending upon the depth of holes and distance back from the face, much time and labor is saved. Neither stumps, rocks, nor gravel impede the action of the dynamite. The banks are thrown down into the roadway in loosened condition to be loaded on the wagons and hauled away, or in shape to be drawn away in scrapers and used for fills.

I have actually known of cases where dynamite has thrown down as much dirt as a result of 20 minutes' work putting down and loading holes as teams and rooters could remove in a day and at a cost much less than team and labor hire. Even when a steam shovel is used, we have found it to be economical to use dynamite in loosening banks because the steam shovels are enabled to operate much faster on the loosened soil.

TERMS USED IN CONNECTION WITH ASPHALT FOR HIGHWAY WORK

(Editor's Note:—The following definitions of terms used in connection with asphalt for highway work, with explanatory comment, is a reproduction, made by permission, of Brochure No. 5 recently issued by The Asphalt Association. We believe this discussion of terms is especially helpful and are glad to place it on record in a form ready available to our readers. The various brochures issued by the association are of great interest to engineers and other public officials and to all interested in paving work).

Some confusion exists in the popular mind, and to some extent among highway engineers, in connection with terms relating to highway work in which asphalt is used. To many, asphalt has always been surrounded with a certain sort of mystery that has been heightened rather than clarified by various scientific or highly technical reports which have been published from time to time. The purpose of this brochure is to set forth in plain language the meaning of certain terms and to explain their relationship to other terms in order to prevent their inadvertent misuse. In general, involved technical definitions will not be discussed although a number of such have been widely adopted as standard.

The Terms Bitumen and Asphalt

The word bitumen was at one time applied only to certain naturally occurring materials of more or less solid consistency which were black and sticky, and which were usually associated with rock or clay deposits. In connection with highway work this term now includes that portion of petroleum asphalt and tar products, whether crude or refined, which is soluble in a liquid chemical substance known as carbon disulphide. The term bituminous material is even broader in its scope and is applied both to bitumen and materials containing bitumen. The amount of bitumen in a bituminous material, as determined by its solubility in carbon disulphide, is frequently reported as total bitumen in connection with laboratory tests.

Asphalt is a semi-solid or solid sticky product formed

by the partial evaporation or distillation of certain petroleums. If the asphalt has been produced by natural agencies it is called native asphalt and often occurs mixed with considerable quantities of water, gas, vegetable matter and earth or clay. If, on the other hand, the asphalt is directly manufactured from petroleum, it is sometimes called petroleum asphalt and is practically pure bitumen. When asphalt occurs impregnating a porous rock such as sandstone or limestone, it is called rock asphalt. This material contains only a limited amount of bitumen and is mostly rock.

Terms Relating to the Preparation of Asphalt

The term asphalt cement, ("A. C.") is applied to an asphalt which is of suitable consistency for direct use in highway work. If the asphalt is too hard for direct use but is otherwise suitable it is called refined asphalt ("R. A."). When an asphalt is manufactured from petroleum it is usually made directly into an A. C., although it may, if desired, be turned out as R. A. Crude native asphalt is almost invariably subjected to a refining process in order to remove the vegetable and mineral impurities as completely as possible. The refined product is then an R. A. which may still contain an appreciable amount of impurities. Before use in highway work all R. A., whether produced from native asphalt or directly from petroleum, must be softened to suitable consistency by combining it with a flux. Flux or flux oil is a non-volatile liquid produced from petroleum by distilling off the lighter and more volatile constituents. It may be mixed with melted R. A. in proper proportions to form an absolutely homogeneous fluxed asphalt or A. C. of any desired consistency. The fluxing process is usually conducted at a paving plant in the manufacture of paving compositions.

Sometimes an A. C. of suitable consistency for a given purpose is thinned to fluid consistency with a volatile petroleum distillate such as gasoline. The resulting product is then called cut-back asphalt and upon exposure will rapidly become an A. C. through evaporation of the light solvent. An A. C. may also be thinned to fluid consistency by the addition of water provided an emulsifying agent such as soap is present in the mixture. When combined with water in this manner the product is called emulsified asphalt. The term liquid asphalt is sometimes applied to a fluid petroleum product or road oil which is highly asphaltic in character and possesses the property of adhesiveness or stickiness to a marked degree. An asphaltic petroleum is one which contains a considerable amount of asphalt dissolved in the lighter oils present and from which asphalt may be readily manufactured by evaporation or distillation to remove these light oils. Certain asphaltic petroleums are quite similar to cut-back asphalt, in which case they are sometimes called malthas.

Terms Relating to the Physical Properties of Asphalts

The hardness of an asphalt is expressed as penetration, which is a measure of the depth to which a standard needle will penetrate it at a standard temperature during a definite period of time when the needle is loaded with a known weight. Unless otherwise indicated, the temperature, weight and time factors are understood to be 25 deg. Centigrade (77 deg. Fahrenheit), 50 grams, 5 seconds. The depth of penetration is expressed in units. Thus a 50 penetration asphalt is one in which the standard needle penetrates to a depth of 50 units. Asphalt of 100 penetration is a softer grade because under the same conditions of test the needle will penetrate it for a depth of 100 units. Thus the softer the asphalt the higher its penetration, and the harder the asphalt the lower its penetration becomes.

The ductility of an asphalt is expressed as a measure of the distance which a standard briquet of the asphalt will stretch without breaking, at a standard temperature, when the ends of the briquet are pulled apart at a definite rate of speed. The temperature is usually specified as 25 deg. Centigrade (77 deg. Fahrenheit) and the rate of speed is 5 centimeters per minute. Ductility is then expressed as the maximum number of centimeters which the test specimen will stretch without breaking. Thus a ductility of 40 means that the briquet will not break until pulled apart for a distance of 40 centimeters.

The melting point of an asphalt is that temperature at which it softens sufficiently to flow as determined by an arbitrary method. Upon being subjected to a rising temperature there is no critical point at which asphalt suddenly changes from a solid to a liquid, as it gradually becomes softer and softer. The melting point test is ordinarily made by first moulding the asphalt in a circular brass ring which is suspended under water beside a thermometer. A standard steel ball is placed upon the upper surface of the test specimen and the temperature of the test specimen and the temperature of the water is then raised at a standard rate. The temperature at which the steel ball forces the asphalt 1 in. below the brass ring is expressed as the melting point. Other methods have also been devised which, for identically the same asphalt, will show a different melting point. It is therefore important that the exact method of testing be known in connection with any statement of the melting point of an asphalt.

The flash point of an asphalt is that temperature at which it evolves vapors which ignite upon contact with a flame. This temperature is and should be higher than any to which the asphalt should be heated during its application in highway work.

The loss by volatilization of an asphalt is the per cent. by weight which it loses when a sample is heated and maintained at a temperature of 163 deg. Centigrade (325 deg. Fahrenheit) for a period of 5 hours under standard conditions of test.

Pavements and Foundations

Highways in which asphalt is used are almost invariably composed of two or more courses. The upper or wearing course is called the pavement provided it has a substantial thickness, usually of one or more inches. When asphalt is used in the superficial treatment of any pavements to produce, with a subsequent application of stone chips, sand, etc., a thin blanket course, such superficial course is called an asphalt carpet or asphalt seal coat.

The bottom course of a highway which is laid directly upon the subgrade, is ordinarily called the foundation or base and if courses are placed between the foundation and pavement they are called intermediate courses. When

subgrade conditions are particularly bad a course is sometimes placed below what would ordinarily be considered the foundation, in which case it is termed a sub-base.

Asphalt pavements are laid upon a variety of foundations or intermediate courses which may or may not be of the same type as the pavement proper. The most common types of foundation are the broken stone or macadam foundation, the Telford foundation, the cement concrete foundation, and the bituminous concrete foundation. Asphalt pavements are frequently laid upon old pavements such as macadam, cement concrete, brick or stone block, in which case the old highway structure as it exists is usually referred to as foundation.

Classes of Asphalt Pavements

The asphalt Macadam pavement is a broken stone pavement laid in a manner similar to ordinary Macadam, except that the broken stone of the wearing course is coated and filled with asphalt applied by the pouring or penetration method after the stone has been placed on the road. Such application may be made with hand pouring pots or by mechanical pressure distributors. No Macadam pavement which has merely been surface treated with asphaltic road oil, cut-back asphalt, or asphalt emulsion should be called an asphalt Macadam. Such indiscriminate use of the term is not only misleading but places a relatively high and permanent type of construction in the same class with waterbound Macadam which is temporarily maintained by surface treatment.

An asphaltic concrete pavement is one composed of a mixture of asphalt with broken stone, broken slag, or gravel and often with sand and mineral filler as well. The term concrete presupposes a mechanical mixture prepared before laying. When the aggregate of asphaltic concrete is composed of a single commercial size of broken stone such as used in the wearing course of Macadam, the resulting pavement has sometimes been erroneously referred to as asphalt Macadam. Such practice should be discouraged as the asphalt Macadam is always constructed by the penetration method. There are a number of patented pavements belonging to the asphaltic concrete class, such as "Bitulithic," "Warrenite," "Bitoslag," "Ameisite," "Filbertine," etc. An unpatented pavement, known as the "Topeka" type, is an asphaltic concrete in which the individual particles of the mineral aggregate range in size from one-half in. in diameter to dust.

The asphalt block pavement is one constructed of blocks composed of a dense asphaltic concrete which has been subjected to heavy compression during the process of moulding. Such blocks are laid in regular courses as in the case of a brick pavement.

The sheet-asphalt pavement is composed of a mechanical mixture of asphalt with a carefully graded sand and a mineral filler such as limestone dust. The mixture is often called sheet-asphalt topping or surface mixture, and is usually laid on an intermediate course of asphaltic concrete known as the binder or binder course. In some localities asphalt is mixed with local sand which does not meet the standard grading requirements for sheet-asphalt. A pavement constructed of such a mixture is greatly inferior to sheet-asphalt and is usually called an asphalt sand pavement.

A rock asphalt pavement is one in which the wearing course is constructed of natural rock asphalt which is usually crushed or pulverized first and in which is sometimes incorporated additional asphalt or flux oil.

An asphalt-earth pavement is one composed of a mechanical mixture of asphalt with finely divided earthy material such as clay. The "National Pavement," which is patented, belongs to this class.

The term asphalt seal coat is often employed in connection with the use of asphalt in the surface treatment of asphalt Macadam and certain asphaltic concrete pavements, either during or after construction. In such cases the asphalt serves to fill the surface voids in the pavement and when covered with stone chips, fine gravel or sand produces an asphalt carpet or mat which protects the underlying pavement.

Asphalt Fillers

Asphalt fillers are prepared for filling joints and cracks in brick, stone block and cement concrete pavements. There are three general types of asphalt filler.

The poured joint filler is a specially prepared asphalt which may be heated and poured into joints or cracks.

The asphalt-grout filler is a mechanical mixture of asphalt and fine sand which while hot may be poured over the pavement surface and broomed or squeegeed into the joints.

The prepared joint filler may consist either of specially prepared asphalt in the form of premoulded strips, which are inserted in the joints, or they may be premoulded mixtures of asphalt with such substances as limestone dust, silica or shoddy dust. Sometimes the filler strips are reinforced with fabric and sometimes they consist of one or more layers of fabric or felt saturated with asphalt. Premoulded expansion joints reinforced or armored with metal are also manufactured.

Distinction Between Asphalts and Tars

Asphalts are quite different from tars, both in their physical and chemical properties. This fact should be clearly understood in order to prevent confusion in the common use of the word bituminous, which is applied to pavements and products which may contain either asphalt or tar. Thus a bituminous macadam pavement may be either an asphalt macadam or a tar macadam and a bituminous filler may be either an asphalt filler or a tar filler. Therefore, whenever it is desired to identify a product or pavement with the material used, the term bituminous should be replaced with the term asphalt or tar as the case may be.

STREET CLEANING, REFUSE DISPOSAL AND SNOW REMOVAL IN BUFFALO, N. Y.

By George H. Norton, City Engineer, Buffalo, N. Y.

Street Cleaning

In street cleaning in Buffalo for many years the old horse brooms had been used preceded by an attempt at sprinkling. A few years ago the condition was reached where the equipment of the contractor was obsolete. A renewal of the contract did not seem desirable.

Three appraisers were named by the Council, with consent of contractor, to appraise the whole plant, which consisted mainly of horses, mules, broom sweepers, wagons, sleighs, horse equipment and leased barns.

After some adjustments the prices of the appraisers were opposed and the plant taken over by the city. At the same time similar action was taken on the plant of contractor for garbage collection. With these two plants the city found itself possessed of a large assortment of junk located at seven different barns or yards. As fast as possible these were consolidated into two locations; old horses replaced by good ones, repair shops located and the old rolling stock repaired. This was a slowly continued process of improvement until motorization became commercially and mechanically advisable.

Motor Flushers

The first step was in the purchase of flusher equipment for street cleaning. It was evident that no half way measures in equipment would be wise.

A beginning was made with three Pierce-Arrow motor tractors, each drawing a 2,000 gal. tank flusher trailer, having two wheels in rear and front carried on the tractor. These were furnished by the Hvaas Co. With these in use it was at once apparent that a proper and economical method of street cleaning had been reached. Three more were added and then nine more, making the present fleet of 15. The results both as to cleanliness and cost are excellent. The one improvement which yet seems desirable is a successful scraper and pick-up machine. Hand brooming or sweeping is not in line with today's requirements. It would appear that some device of the squeegee kind with pick-up would add materially to satisfactory street cleaning.

The effect of flushing material into sewers through inlets seems to be so dependent upon grades and crowns of pavements, width of street, and frequency of cleaning, as well as kind and size of sewers, that nothing definite can be said as generally applicable.

The above mentioned combination of tractor and flusher seems most appropriate in this Northern city. Flushing cannot well be done in freezing weather. But upon the advent of the freezing weather the quantity of coal and ashes is greatly increased and snow removal becomes necessary. This separable arrangement of tractor and flusher is then economical. The flusher is housed and the tractor augments the hauling equipment when most needed.

Snow Removal

In this Northern city during a normal snow season the auto traffic is forced onto the car track streets unless regular snow removal is maintained on other streets. A few years ago this was of little moment; today it is vital.

With the large fleet of tractors it will now be possible to fight a snow storm from its beginning and keep all thoroughfares open. The feature of elasticity seems to make this combination the most desirable.

Refuse Disposal

In refuse disposal this city has also been guided by results obtained through step by step experience. For many years the public dump was economical. City growth with less available dumps and longer hauls made another method desirable. When the collection was made by contract an arrangement was made with the contractor to build a destructor plant for refuse in city property with right of city to acquire at expiration of contract at 60 per cent. of cost, but before expiration of contract the city took it over at an agreed price.

The old "Morse-Boulzer" furnace was replaced by two "Henan-Froude" furnaces.

All rubbish is assorted and the salable reclamation sold. Many figures might be given but such are so dependent upon market conditions that such would be of little general value. The city fortunately had a good market for its recovered paper, and with such, over a long term of years, this plant has proven just about self-supporting. The quantity of recoverable material has been greatly affected by war conditions and market prices have been variable. The general average of self-support, however, is most satisfactory as it solves the question of dumps and long hauls.

Garbage disposal has been the most troublesome and unsatisfactory. Under the old contract system the collection and disposal was done by a fertilizer company, the garbage being taken to their plant for reduction.

For some reason this reduction seemed less and less desirable even after the city made collection and delivery of garbage and a material price demanded to accept delivered garbage.

The increasing success of hog feeding has been closely followed and in 1919 bids were requested for both reduction and feeding. The first proposals eliminated reduction but so complicated the feeding that new bids were received and contract made on basis of top price of hogs in Chicago on monthly averages and amount of garbage delivered:

6 times for 25,000 tons per year
7 times for 30,000 tons per year
8 times for 40,000 tons per year

While this contract is but recent, it promises a reasonable solution of the garbage problem. Haulage is yet to be settled. The separable tractors used for flushing assist materially. Small trucks have been tried but with small success. Several patterns of trailers are now being tried as to comparative merits.

This brief outline has been given as perhaps typical of a city's experience. Figures in detail from one locality may prove most misleading at another unless the conditions are quite parallel and this is seldom the case.

Sound judgment, a knowledge of the difficulties of other cities, courage and opportunity for reasonable trial of new methods seem the essentials for reasonable progress in the "housekeeping of cities."

The foregoing matter is the major portion of the report of the Committee of the American Society for Municipal Improvements of which Mr. Norton was chairman.

GARBAGE DISPOSAL AND THE ECONOMIC RECOVERY OF VALUABLE CONSTITUENTS OF MUNICIPAL WASTE

By Samuel A. Greeley, Hydraulic and Sanitary Engineer
39 W. Adams St., Chicago, Ill.

The subject matter of this paper covers a large and important field of municipal activity. It is not within its scope to reach many of the details of the processes re-

quired for the economic recovery of valuable materials from municipal refuse and the paper deals very largely with general principles and the limitations attending their application.

The term "Valuable" is, furthermore, difficult to use with any degree of certainty under present market conditions. Only the most careful consideration of local are good after 12 years' service. The majority of walkbility can justify definite conclusions. The author has therefore undertaken this task with much hesitation.

Particular attention is directed to the importance of local conditions in developing methods of garbage disposal.

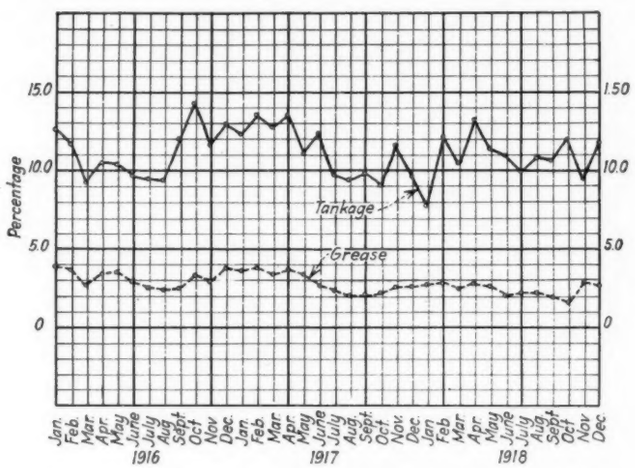


FIG. 1. MONTHLY PERCENTAGE RECOVERY OF GREASE AND TANKAGE AT CLEVELAND REDUCTION PLANT 1916-1918.

another by reduction, etc. Matters of administration, stage of city development, past experience and training in garbage disposal, location, climate, character of population, topography, soil and many other factors are pertinent.

Fundamental Considerations

Broadly speaking a method of final disposal of municipal refuse should serve three functions as follows:

(a) It should render satisfactory service to householders.

(b) It should be measurably clean and sanitary.

(c) It should be reasonably economical.

In accomplishing these three ends, there are four parts or phases of the problem to be developed as follows:

(a) The House Treatment.

(b) The Collection.

(c) The Transportation.

(d) The Final Disposal.

The problem of garbage disposal is the proper development and adjustment of these parts of the problem to local conditions. The house treatment more directly affects the people; the collection is generally the more costly part of the work; transportation other than in collection wagons is needed only in the larger communities; while final disposal involves more engineering work and in general stimulates more discussion than the others. In the author's opinion, each of the four phases is equally important and a limitation of what follows primarily to disposal is not intended to eliminate or discard the influence of house treatment, and collection upon the disposal.

Two other fundamental considerations are important viz. (a) the so-called relative values in sanitation and (b) the fact that a successful handling of the refuse problem revolves primarily about operation. By relative values is meant such items as, for instance, the stage of other municipal improvements possibly more directly affecting the public health as well as the question of the proper cost of measures for eliminating odors not constituting a general nuisance. It is also obvious that "Operation" looms large in refuse disposal work and must be given first consideration during the development of new works.

Valuable Constituents

Refuse is the term for the solid waste resulting from community activities as distinguished from sewage. Refuse is made up of garbage, ashes, rubbish, manure, and many other materials. The valuable constituents contained in them are as many as the varied activities of the community. These constituents may, however, be roughly classified by the methods (of disposal) used to recover them thus:

(a) Dumping or land fill makes the fullest use of the inert constituents of refuse not otherwise generally useful. Sometimes valuable land can thus be made.

(b) Burial or ploughing into the soil makes possible the recovery of those constituents of refuse which are valuable for fertilizing the soil. Manure is quite generally disposed of in this way and some cities have developed its collection and transportation to farming districts very advantageously to the public comfort and the municipal

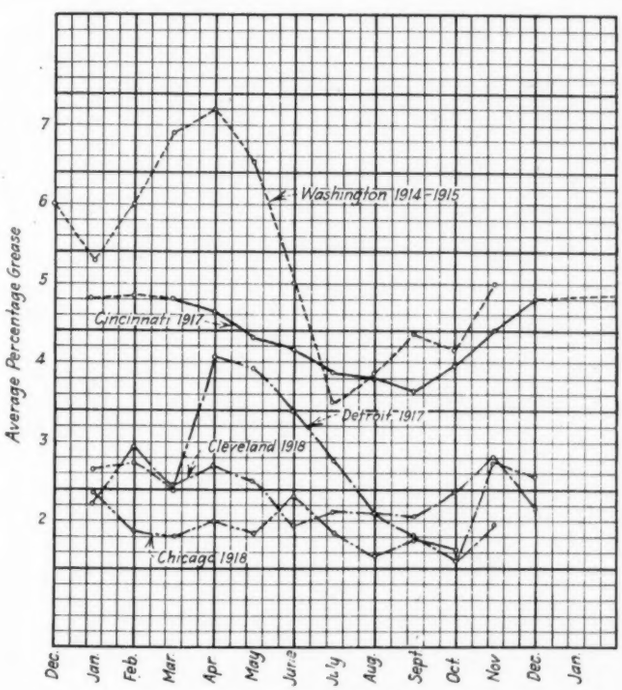


FIG. 2. MONTHLY PERCENTAGE RECOVERY OF GREASE AT VARIOUS GARBAGE REDUCTION PLANTS.

pocketbook. At Columbus, Ohio, a gross revenue of about $4,000 per year is derived from the sale of manure. Street sweepings are also used in this way, sometimes, for instance, to cover dumps of mixed refuse for park purposes.

(c) Mixed refuse can be burned at high temperature

with the production of steam suitable for power development, thus recovering or using the carbon and hydrogen contained in the refuse. With the increased demand for power, the higher price of coal and oil, and the gradual reduction in available close-by dumping areas, the value of refuse for steam production is increasing.

(d) Garbage contains grease and tankage, both valuable constituents which are being economically recovered on a large scale by the reduction process.

(e) From rubbish many marketable materials can be recovered, such as paper, rags, leather, old metals and the like. The process is commonly termed rubbish sorting.

(f) An old and universal method of recovering the valuable food constituents from garbage is by feeding to hogs. This is one of the most interesting and useful methods of garbage disposal which has recently been given much prominence by the war shortage of food.

(g) There are many other processes for the recovery of valuable constituents from garbage which have been more recently studied, such as the production of alcohol and the preparation of a stock and chicken food.

Some of the more generally used of these methods of recovery are commented on in the following sections:

Hog Feeding

For garbage alone, feeding to hogs is a method of disposal which undoubtedly has a wide field. By this method the food constituents of garbage are recovered in part. During some tests during an investigation of the refuse disposal problem made by the writer in Louisville, Ky., it was found that 32.4 lbs. of city garbage were required to add 1 lb. to the weight of the hogs. The tests lasted seven weeks and covered observations on the feeding and growth of 25 to 40 hogs. The garbage was taken from several collection districts, but contained a somewhat smaller amount of other refuse materials than much city garbage. With pork on the hoof at 15 cts. a pound, the garbage would have a gross value of $9.26 per ton. It was actually sold by the city at this time (September, 1918) at $3 to $3.50 per ton for feeding to hogs.

At Worcester, Mass., where the separation of garbage is very good, it takes 37.5 lbs. of garbage per pound gained by the hogs.

Hotel garbage has a higher food value. Mr. Gaumnitz, who feeds much hotel garbage in St. Louis, states that it takes 25 lbs. of garbage to make 1 lb. of gain on a hog; and this data is confirmed by tests at the Iowa Agricultural Experiment Station. At 15 cts. per pound of pork, hotel garbage would thus have a gross value for feeding purposes of $12 per ton.

From the gross indicated value of garbage for hog feeding it is, of course, necessary to deduct plant operation, risk, overhead, fixed charges, etc. These vary with the location of the hog farm, the value of the land, the climate, the length of the contract and the care with which the operation of the farm is conducted. In 1916, in connection with a study of garbage disposal in Worcester, Mass., the writer estimated the total annual cost at $2.30 per ton, which was considered rather liberal at that time, but was predicated on an ample plant and good operation. As a matter of fact contractors seem willing to pay not much over $1 per ton for city garbage, and in some cases less, some contract prices being as follows:

Town	Year	Price paid by Contractor to City per ton of delivered garbage
Minneapolis, Minn.	1918	$1.26
Grand Rapids, Mich.	1917	.45
Portland, Ore.	1918	3.90
Newark, N. J.	1919	1.20*
St. Paul, Minn.	1917	.80
South Bend, Ind.	.....	.....
Anderson, Ind.	1917	1.00

Note *: Figured at 8 times the price of live pork in Chicago.

Metals—

The operation of hog farms is not an easy matter and varies considerably in different places, which may possibly explain the abandonment of hog feeding as a method of disposal in some cities. Of first importance is a superintendent who knows the feeding and care of hogs. But sanitary considerations are likewise important and must supplement the experience of the hog feeder. The more important items are:

(a) Methods of feeding. (b) Area required. (c) Pens and runways. (d) Vaccination. (e) Disposal of unconsumed garbage. (f) Suppression of rats and flies.

The design will depend somewhat upon the location of the hog farm. For instance, in a report on hog feeding of garbage at Rockford, Ill., the writer recommended that "No garbage be fed to hogs in buildings closer than 300 ft. from a traveled roadway, and that garbage fed out of doors on platforms should be at least 600 ft. away." Of paramount importance, however, are matters of house treatment, frequency and adequacy of collection and other items affecting the public comfort and the quality of the garbage.

Incineration

The carbon contained in refuse is a valuable constituent. The carbon content of garbage is low, generally less than 5 per cent., and is not sufficient to warrant economical recovery. However, the carbon content of ashes and rubbish is higher, and so-called "Mixed Refuse" (garbage, ashes and rubbish as collected from houses) contains as much as 20 per cent. of carbon. This gives it a value of about one-fourth that of coal (80 per cent. carbon), and as many municipalities are now paying upwards of $5 per ton for coal in pumping stations and lighting plants, the indicated gross value of a ton of mixed refuse is $1.25. Assuming an average evaporation of 1 lb. of steam from and at 212 deg. F. per pound of refuse, this is equivalent to 6¼ cts. value per 100 lbs. of steam as compared with 4 cts. per 100 lbs. of steam used in the Milwaukee incineration tests in 1910.

A plant to burn mixed refuse should be especially designed for that purpose and should preferably be designed and built from plans and specifications prepared by (or for) the municipality instead of from general plans offered by contractors. Proper combustion without nuisance and longer life are thus likely to be secured. The details of design cannot be taken up in this paper, but there are a number of plants which have been giving good service for periods up to 12 years in this country, as at Savannah, Atlanta, Milwaukee, West New Brighton, Westmount and elsewhere. A record of power production at the Milwaukee refuse incinerator is shown in Table I and a record of operation of the refuse incinerator at Westmount, Canada, in Table II.

In projects for mixed refuse incineration the effect of collecting the refuse mixed on the house treatment and cost of collection are important factors.

TABLE I—POWER PRODUCTION AT REFUSE INCINERATOR, MILWAUKEE, WIS.

Month 1917	Total K.W. Hrs.
January	3,466
February	.....
March	.....
April	59,160
May	32,985
June	32,072
July	86,404
August	118,249
September	107,057
October	59,607
November	16,884
December	.....
	515,794

Notes:

	Average percentage of refuse incinerated
Garbage	68.84
Ashes	26.49
Rubbish	4.49
Manure	0.17

Average evaporation per pound of mixed refuse, 1.626 lbs.
Data from 1917 Ann. Report Dept. of Public Works.

Rubbish Sorting

Rubbish contains much material which can be sorted out and sold, such as paper, rags, metals, rubber, shoes and the like. During the war the government urged that this should be done as a conservation measure, and there appears to be no reason why the practice is not good.

The gross value of rubbish varies with the market over a wide range. From 35 to 50 per cent. of the rubbish by weight can usually be recovered under normal city conditions. These materials bring in a gross revenue of about $2 per ton of rubbish on pre-war prices. The figures from the Columbus municipal rubbish sorting plant are given in Table III. The selling price or rubbish materials in the Chicago market from quotations dated November 7, 1919, are as follows:

Metals—	
Copper	$ 0.16 per pound
Light Copper	.15
Brass, Red	.16
Brass, Heavy Yellow	.10½
Brass, Lighter Yellow	.09
Brass, Yellow Boring	.09
Brass, Red Boring	.14
Lead	.05¼
Zinc	.05
Mixed Iron	12.00 per ton
Rags—	
Mixed Rags	.03 per pound
Bagging	.02
Paper—	
Newspaper	.70 per 100 lbs.
Mixed Paper	.60 per 100 lbs.
Rubber—	
Automobile Tires	.03 per pound
Tubes	.09 per pound
Mixed Boots and Shoes	.07 per pound
Arctic Shoes (cloth covered)	.04 per pound

A rubbish sorting plant comprises a receiving room and a wide belt conveyor traveling slowly up between two platforms on which the sorters stand. Along the outside of each platform are bins for storing the sorted-out material. Below the bins are baling presses and other apparatus used to prepare the materials for shipment. An incinerator, usually with a boiler, is required to burn the unsorted rubbish. Such plants are in operation at Buffalo, Rochester, Pittsburgh, Columbus and elsewhere; and in many places rubbish materials are sorted out on the dump and sold. The revenue from the sale of the sorted-out materials does not usually much more than pay for the cost of operation.

TABLE III—REVENUE FROM MUNICIPAL RUBBISH SORTING PLANT AT COLUMBUS, OHIO.

	1918	1917
Bottles	$ 116.33	$ 365.21
Paper	1,876.06	1,859.06
Iron	58.19	145.53
Rags	239.45	579.94
Cans	1,600.31	452.59
Metal	5.50	114.39
Miscellaneous	28.26	5.03
	$3,924.10	$3,521.75

Reduction of Garbage

Reduction of garbage is a chemical and mechanical process whereby the garbage is separated into four parts, viz., volatile matter driven off as gas, water, grease and a dry material which is somewhat stable, mostly fibrous and of vegetable and animal origin, and is called tankage. The grease and tankage have market values.

The mount of these materials which can be recovered depends upon the character of the garbage and the process used for recovery. Two and one-half per cent. of grease and 11 per cent of tankage by weight of raw garbage may be recovered (see Figs. 1 and 2). The gross value of these constituents depends upon the market price, which varies greatly, as shown in Table IV. The present market price of grease is about 6 cts. and of tankage about $10 per ton, which would indicate a gross value of garbage for the reduction process of $5.10 per ton. During the war these prices were doubled.

Many processes have been devised for reducing garbage, most of which fall into one of three groups, designated as follows:

(a) Drying Method.
(b) Cooking Method.
(c) Cobwell Process.

TABLE IV—VALUE OF PRODUCTS FROM GARBAGE

	Market Price of Grease Cents per Pound			Market Price of Tankage Dollars per Ton		
	Chicago	Cleveland	Columbus	Chicago	Cleveland	Columbus
1913	....	4.26c	3.73c	....	$6.00	$6.79
1914	....	4.17	4.32	....	6.75	7.41
1915	....	4.41	3.76	....	8.75	7.00
1916	7.29c	6.50	5.17	$4.16	7.75	8.50
1917	7.34	8.00	7.50	4.16* 10.27**	9.58	10.84
1918	11.57	13.50	11.76	10.27* 16.85**	18.50	20.50
1919	....	5.0-7.6	....	....	10.00	

Note: * To August 1st. ** Balance of year.

The Cobwell process is the most recent and may be described as the "dehydration or drying of the garbage by cooking at low temperature while immersed in a solvent, the extraction of grease from the dried garbage by the same solvent, the recovery of the solvent for

TABLE II—SHOWING FIXED CHARGES, OPERATING COST AND REVENUE OF WESTMOUNT REFUSE INCINERATOR.

Item	1907 10 months	1908	1909	1910	1911	1912	1913	1914	1915	1916
No. of tons of refuse	10,704	13,641	14,331	15,280	17,008	20,878	18,731	23,800	20,800	19,500
				Cost Per Ton						
Fixed Charges—										
Interest	$0.19	$0.13	$0.19	$0.25	$0.25	$0.21	$0.23	$0.18	$0.20	$0.22
Sinking Fund	0.04	0.08	0.06	0.08	0.07	0.05	0.05	0.04	0.05	0.05
Loss on Bonds, proportion	....	0.01	0.004	0.004	0.004	0.003	0.003	0.002	0.002	0.002
Depreciation	0.13	0.12	0.15	0.21	0.21	0.17	0.17	0.15	0.16	0.17
Operating Charges	0.55	0.52	0.46	0.48	0.59	0.48	0.65	0.55	0.65	0.71
Total Cost	$0.91	$0.89	$0.86	$1.02	$1.12	$0.91	$1.10	$0.92	$1.05	$1.15
Revenue	0.36	0.31	0.40	0.40	0.46	0.40	0.45	0.48	0.48	$0.46
Net Cost	$0.55	$0.58	$0.46	$0.62	$0.56	$0.51	$0.65	$0.44	$0.57	$0.69

TABLE V—MATERIALS RECOVERED AT CLEVELAND AND COLUMBUS REDUCTION PLANTS

Year	Cleveland			Columbus		
	Total tons of garbage reduced	Percentage of total garbage recovered		Total tons of garbage reduced	Percentage of total garbage recovered	
		Grease	Tankage		Grease	Tankage
1905	30,382	2.63				
1906	34,891	3.07				
1907	37,606	3.14				
1908	41,242	3.46	9.2			
1909	44,525	3.70	11.3			
1910*	44,747	3.75	13.2			
1911	46,562	3.53	12.8	17,534	1.85	12.9
1912	43,555	3.38	11.5	18,789	2.72	11.6
1913	52,384	3.13	9.7	20,711	2.72	10.5
1914	55,730	2.95	10.5	21,629	2.73	9.7
1915	66,271	2.81	10.4	22,909	2 21	10.0
1916	63,450	3.06	11.2	21,862	3.08	10.3
1917	56,121	2.73	11.3	17,127	2.26	10.21
1918	57,254	2.36	11.0	15,630	2.16	10.26

* At Columbus operation began in July, 1910, and there was no percolation until January, 1912.

further use, and the production of grease and dry tankage for the market." Almost all of the action takes place in closed reducers and the connections. At New Bedford, Mass., the recovery by the process is stated to be 4 per cent. of grease and 15 per cent. of tankage, and at Los Angeles, Calif., 15.5 per cent. of grease and 3.1 per cent. of tankage.

In the drying method the garbage is first dried and then degreased in naphtha percolators. The grease recovery is comparatively low and the tankage recovery somewhat higher than in other processes. Thus at the Chicago reduction plant, which uses the drying method, the percentage of grease recovered is 2.0 and of tankage 22.7 for the year 1918.

The cooking method comprises a first cooking of the garbage with live steam under pressure, then pressing out the free water and grease, then drying the pressed material and finally recovering additional grease by percolation with a solvent. This process is used at Cleveland, Columbus and elsewhere. The percentage of grease and tankage recovered is shown in Table V. Garbage reduction plants are usually located at some distance from built-up districts which requires a transportation of the garbage. This and other local factors such as size of city should be considered in connection with this method of disposal.

Miscellaneous Methods

There are, in addition to the more generally used methods mentioned above, several comparatively new methods not yet tried out on a very large scale. The Union Poultry Food Company of Los Angeles have a process which consists in placing the garbage as collected in a direct heat steam dryer. The dried product, which amounts to about 18 per cent. by weight of the garbage, is sold for poultry food, bringing as high as $40 per ton. This would indicate a gross value of the garbage of $7.20 per ton. The process has been considered at Kansas City, Mo.

A process for the production of alcohol from garbage under patents held by Dr. S. J. Morgan has been tested (1916) on an experimental basis at Columbus, Ohio. These tests showed a possible yield of 4.8 gals. of alcohol per ton of garbage, which at 40 cts. per gallon indicates a gross value of $1.92 per ton of garbage. It appeared from the tests that the recovery of grease and tankage was not materially affected by the alcohol recovery process.

There are, of course, other processes such as that of Dr. Hirsh, recently considered at St. Louis, which the inventor guarantees will yield "at ordinary market prices" not less than $3.60 per ton of garbage; the "Nufuel" or "Oakoal" process for making fuel briquettes and others. There is not space for further comment.

Summary

The writer does not feel justified in offering any conclusions to this paper except that garbage disposal should be considered with a view, where possible, to an economic recovery of valuable constituents. The lure of profit, however, should not overshadow the development of operation for the convenience and comfort of the householder and for the economy of collection. It is a mistake to arouse public opinion on the matter of disposal where other parts of the problem are of equal importance and sometimes more costly. Nevertheless economy of operation, elimination of waste, the salvage of useful and essential materials are matters of vital importance in the present development of society and the skill and efficiency with which they are done will reflect the general progress of the community. This means that the economic value of valuable constituents of garbage and other refuse materials must be considered with the house treatment and collection, first cost of plant, overhead and fixed charges and costs of operation. When and where the problem is approached in this broad, sound way the writer believes that methods of disposal involving the recovery of valuable constituents will endure and will permit of operation without the interruptions and changes of methods which now occasionally occur.

Acknowledgment

The foregoing paper by Mr. Greeley was presented before the annual convention of the American Society for Municipal Improvements:

PAYMENT FOR PREPARING THE SUBGRADE; HOW ROCHESTER, N. Y., SOLVED THE PROBLEM

By J. O. Preston, C. E., Assistant Engineer, Rochester Bureau of Municipal Research, Inc., Rochester, N. Y.

Bid prices for pavement construction generally are itemized to the extent of being divided on the square yard basis and yet contractors seldom know what the item finally will include. The general practice in 15 of the 33 cities from which data has been collected is to include the work of displacement grading in with the item of pavement foundation, bids being taken only for the latter at a price per square yard. For example, the old specifications for local improvements in Rochester, N. Y., provided,

"In all improvements where pavements (and walks) are laid, all excavation and filling that is necessary to be done must be included in the prices bid for pavement, sidewalks, and other items of work, and will include the removal of all old paving, crosswalks, curbs, etc., that are required to be removed. . . . . such trees (less than 6 ins. in diameter), boulders, or other obstructions as may be in the way of completing the improvement shall be removed from the street by the contractor . . . said price (for pavement or walks) shall include . . . . all the grading, including both excavation and filling necessary to bring the finished surface to the lines, grades

and sections shown on the maps exhibited at the letting or required by the Engineer. . . . ."

Displacement Grading

While the term "displacement grading" means the removal of materials from and the shaping of the cross-section which the pavement displaces, the actual use of the term, as illustrated above, makes it include, practically all volumes of excavation and filling connected with getting the roadway to grade. When the plans called for a very deep cut, under the specifications just quoted, it was sometimes the practice to ask for bids for earth excavation for such cuts but the item was allowed to the contractor only where specifically indicated on the plans.

A Misleading Item

The advantages of using the item of pavement to include grading and miscellaneous excavation and filling are that all areas inside of the street lines are certain to be graded, that the Engineer is not required to take careful or frequent cross-sections and, although an injustice to him, the contractor has small chances of collecting for inaccuracies of earthwork, rock and other items exhibited on the plans and called for in the engineer's estimate. On the other hand, the contractor is at a big disadvantage because he is seldom allowed to take the plans into the field (on municipal work) before making his bid and cannot carefully check the cross-section or quantities if he does manage to get a set of the plans. The cost data based on the bids for this item do not allow fair comparison and moreover the contractor is forced to gamble on the amount of work to be done.

Other factors are involved, such as the fact that accurate quantities help to prevent unbalanced bids, they give the property owners and councilmen real information as to the probable cost of work. The work itself is likely to be delayed because of the engineer being required to ask for authority to exceed the estimate, etc., when the quantities are only approximated.

Units Can Be Too Much Itemized

There is justification in the argument that a separate item for grading, not including displacement excavation and filling, requires too frequent and accurate cross-sections with corresponding lengthy computations in the engineer's or preliminary estimate, in all partial, and on the final estimates. If the work of preparing the subgrade and laying the pavement foundation are made separate items on the bidding sheet, considerable unnecessary work is required unless the definition of the former item is conveniently defined.

When the Rochester Bureau of Municipal Research instigated the complete revision of the engineering specifications for its city, the writer assisted in working out a satisfactory plan wherein frequent and painstakingly accurate cross-sections are not required for minor differences in the crowns of the old roadway and the new pavement surfaces. But the bidders are protected from uncertain excavation and filling quantities.

The New Provisions

In the division of the specifications dealing with the grading of unimproved streets as well as in the part relating to subgrade, prices are required on the item of preparation of the subgrade. The unit is the lineal foot at the width of the right of way for each individual street. The specification for grading unimproved streets provides,

"The cost of grading unimproved streets, as specified . . . . shall be included in the contract price for roadway, sidewalk and gutter grading (grading unimproved streets) and shall include all excavation below a horizontal line drawn between the established grades at the street lines (street width) as shown on the standard plans (see Fig. 1), also the shaping of the roadway and gutters. All excavation above the said horizontal line shall be considered as extra earth excavation and shall be paid for at the contract price for earth excavation.

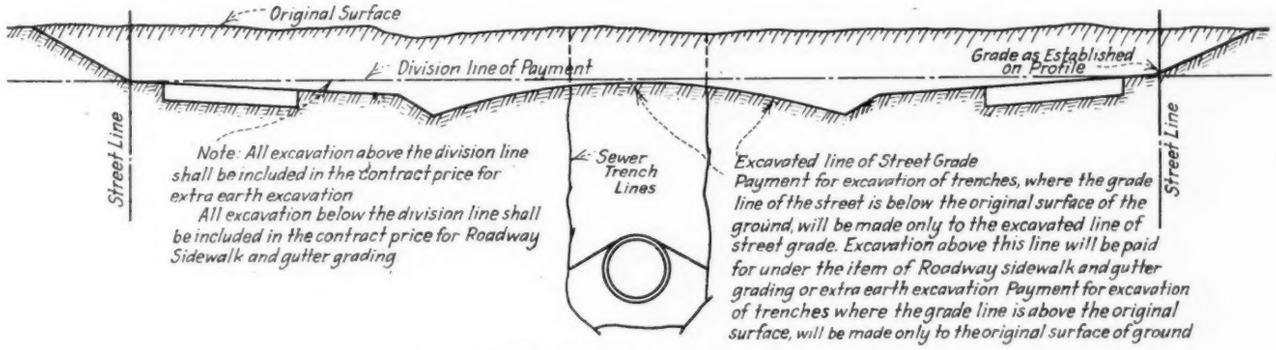

Original Surface
Division line of Payment
Grade as Established on Profile
Street Line
Note: All excavation above the division line shall be included in the contract price for extra earth excavation
All excavation below the division line shall be included in the contract price for Roadway Sidewalk and gutter grading
Sewer Trench Lines
Excavated line of Street Grade
Payment for excavation of trenches, where the grade line of the street is below the original surface of the ground, will be made only to the excavated line of street grade. Excavation above this line will be paid for under the item of Roadway sidewalk and gutter grading or extra earth excavation Payment for excavation of trenches where the grade line is above the original surface, will be made only to the original surface of ground
Street Line

FIG. 1. SECTION OF SEWER, WALK AND GRADING.

"If the embankment exceeds the excavation within the limits of the work, then the additional embankment required, except as provided in . . . . . (refers to clause regarding deficiency of filling) . . . . . will be paid for when authorized by the engineer, according to the contract price for earth embankment.

"Payment for excavation of trenches where the grade line of the street is above or below the original surface of the ground will be paid for in accordance with Division D-1, Section b, paragraph 6."

The last mentioned clause is in the division dealing with trenches and it provides in part as follows.

". . . . . .payment for excavation of trenches, where the grade of the street is *below* the original surface of the ground, will be made only to the 'excavation line' of the street grade as shown on the standard plans (see Figs. 1 and 2); excavation above the line will be paid for either under the item of 'roadway, sidewalk and gutter grading,' 'preparation of subgrade' or 'extra excavation.'

"Payment for excavation of trenches, where the grade line is *above* the original surface, will be made only to the original surface of the ground. . . . . ."

In the division of the specifications concerning the subgrade for pavements it is provided,

"The cost of preparing the subgrade as specified . . . . . except as otherwise provided, and including all excavation below a horizontal line drawn between the established grades at the street line, as shown in the standard sections (see Fig. 2), shall be included in the contract price for preparation of the subgrade. Excavation above the said horizontal line shall be considered as extra earth excavation and will be paid for at the contract price for earth excavation.

"Payment for excavation of trenches where the grade line of the street is above or below the original surface of the ground will be paid for in accordance with Division D-1, Section b, paragraph 6. . . . . ."

The clause last referred to was quoted four paragraphs above.

The excavation required for curbing is provided for in the division of the specifications relating to setting stone curbing which provides,

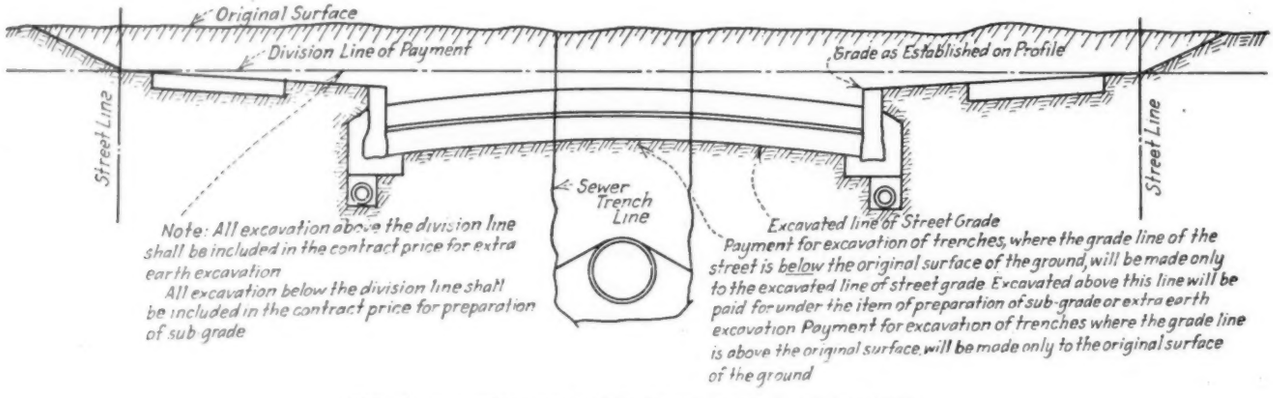

Original Surface
Division Line of Payment
Grade as Established on Profile
Street Line
Street Line
Sewer Trench Line
Note: All excavation above the division line shall be included in the contract price for extra earth excavation
All excavation below the division line shall be included in the contract price for preparation of sub grade
Excavated line of Street Grade
Payment for excavation of trenches, where the grade line of the street is below the original surface of the ground, will be made only to the excavated line of street grade. Excavated above this line will be paid for under the item of preparation of sub-grade or extra earth excavation. Payment for excavation of trenches where the grade line is above the original surface, will be made only to the original surface of the ground

FIG. 2. SECTION OF PAVEMENT, SEWER AND WALK.

". . . . . The cost of excavating for the curb shall be included in the price for the preparation of the subgrade in accordance with Division C-2, page 12, section a, paragraph 8 of these specifications (refers to the clauses quoted four paragraphs above) . . . . ."

Trouble was experienced under the old specifications in getting the pavement contractors to shape the grass plot area between existing walks and the curb but it is evident that the new specifications provide for this work. The new specifications make a separate item and require a bid price for the preparation of the actual subgrade under new walks. The provision relating to this is as follows,

"The cost of preparing the subgrade (for walks) as specified above in . . . . . except as otherwise provided, shall be included in the contract price (per square foot) for the preparation of subgrade for walks . . . . . Where the contracts are for walks only the items for earth excavation shall include all excavation above the finished grade line, as shown on the standard plans, and shall be for such width as indicated by a special section."

The Development of the Clauses

The first effort in preparing the clauses quoted above for the payment for preparing the subgrade was to attempt to define two horizontal lines limiting the excavation and filling to be included with the item of preparation of the subgrade for pavements. The idea was to make one line level with the top of the curbs and the other on a level with the lowest depth of the bottom of the pavement below it. The fact that for very wide streets the crown of the pavement would project through such a top limiting line, that it is desirable to have the shaping of the area between the walk and the curb included and that the varying thickness of different types of pavements make it impractical to set the lower horizontal line, resulted in the method described. The top horizontal line was set level with the intersection of the sidewalk slope, and the property line (see Figs. 1 and 2) and, when a deficiency of filling exists, the contour of the finished subgrade is taken as the lower boundary.

Summary

The method of paying for all work under the new specifications is based on the principle that to insure all essential details being performed properly, they must be itemized into convenient units and the contractor paid for them when performed. The inducement to skimp the work or to bid high for safety is thereby removed. The volume of claims for extras is likewise reduced. All items and questionable points are carefully defined, such as the size of boulders for which the item of rock excavation will be allowed, etc.

The bid prices under the new are more susceptible to comparison than were those under the old specifications. The variation in street widths causes slight discrepancy in comparison of prices for grading but the saving in taking of cross-sections, in computations, etc. more than off-sets this slight fault. The allowance for trench excavation requires some computation but the saving which results makes the effort worth it.

The contractors are more satisfied with the new provisions, there being no doubt as to what the item of preparation of subgrade for pavement or walks includes. The city engineers gladly admit that the item is especially helpful because it makes it considerably easier to prepare partial estimates. There is no doubt but that the method of paying for the items is a vast improvement over the virtually lump-sum bid for the items of pavement or walks complete in place as the old specifications required.

Messrs. E. A. Fisher, C. A. Poole and F. A. Delavau of the City Engineering Department were associated with

J. W. Routh and the writer of the Bureau of Municipal Research in preparing the new engineering specifications from which the above quotations are taken.

DEVELOPMENT AND INSPECTION OF SUPPLIES OF MATERIAL FOR HIGHWAY CONSTRUCTION

By Austin B. Fletcher, State Highway Engineer of California, Forum Bldg., Sacramento, Calif.

It is indeed a day of heavy highway programs; we talk as glibly of forty, sixty or an hundred millions of state highway bonds as we did a few years ago of five or ten millions. We talk now of annual programs of highway construction of from ten to twenty-five millions without particular difficulty, said Mr. Fletcher in addressing the annual meeting of the American Association of State Highway Officials.

But talking about such programs is one thing and getting experienced engineers and assistants, finding enough contractors of sufficient ability and financial responsibility and securing the huge quantities of proper materials of construction promptly is quite another story.

Hardly any two states of the Union have the same problem to solve.

In some of the states where state highway activities are of very recent date the troubles with respect to the supply of materials of construction must be acute and hardly any state has been accustomed heretofore to thinking of the supplies in terms of the enormous volumes we are now facing.

The public now in thinking or speaking of a state highway have in mind an expensively paved road. In general it may be said that the days of gravel or waterbound macadam roads are no more.

Using Local Materials

In most of the states the location of the principal supplies of gravel, sand and broken stone is fairly well known, but for extensive paving operations these supplies must be increased greatly and new deposits located if the highway work is to proceed with the dispatch desired by the public.

Often the engineer must decide whether he can or must use materials of somewhat inferior quality or whether materials of better quality can be shipped to the work by rail. These decisions often require nice judgment and no highway department can consider itself well organized without a geologist competent to assist the engineer in such matters nor unless it have a well equipped testing laboratory with trained assistants to operate it.

Railway Failures

In many instances the material supply difficulty is not so much the lack of material as it is the failure of the railroads to ship it promptly and as ordered. In some states it is notorious that the railroads do not have enough suitable cars to give the needed service and this is true particularly at the crop moving periods. Hardly anything will do more to disrupt a highway contract than the failure of the railroad to furnish the materials of construction as they are needed.

This failure of the railroads, unless it can be corrected otherwise, would doubtless, in some states, under the heavy programs, justify the purchase of railroad cars by the state department for highway use.

If the railroad may be depended upon, the economical way of handling the materials, particularly such stuff as broken stone, sand and gravel, is to unload from the cars and place the materials on the road where they are to be used without unnecessary rehandling, which is always a costly performance.

Stockpiling Material at Convenient Points

Failing prompt railroad service, and in these days we rarely expect regular deliveries, one remedy is to stockpile the materials at convenient points. Sometimes, but not often, it is possible to haul the materials and place them in small piles within the right-of-way but more often they have to be placed in large piles near the railroad sidings.

The use of portable derricks or cranes with clamshell buckets lessens to a large extent the rehandling expense but whether machinery is used or not it seems obvious that the materials must be available when the contractor needs them.

It will also be found that because of the extraordinary number of motor trucks supplied by the Government to the states at an almost negligible cost much material may be hauled in these trucks for long distances. The ton-mile cost of hauling in trucks which cost the states practically nothing is greatly reduced if the factor of original cost of the trucks does not have to appear in the figuring.

State Ownership

Some of the states have adopted the practice of furnishing the materials of construction, or most of them, to the contractors. The writer does not know of any state which has gone so far as to own cement plants and rock quarries and to operate them but that such a policy may have to be adopted by some states is by no means unthinkable. Indeed, the statutes of some states provide for such a contingency. For such states as have become accustomed to supplying the contractors with construction materials it would be a simple extension of their operations.

There is little doubt that the heavy road building program will be in fashion for a long time to come so that the plant construction cost may be distributed over a huge quantity of the product. If the cement companies are unreasonable in their prices, for instance, a means for curbing them is available.

However, the money involved in such undertakings would be in large figures and could be allotted only with difficulty in some cases. "We want the money spent on the roads" is still the slogan of many of the thoughtless voters of state highway bonds.

It must be confessed, too, that under normal conditions no state operated cement plant can hope to compete with a privately operated plant on the cost basis.

Furnishing Materials to the Contractor

There are many advantages and few objections to the state highway department furnishing materials to the contractor. A contractor with little capital is enabled to bid on work since he has little to finance outside of the labor and equipment items.

The contractor has no incentive to scamp on quantity or quality of the materials. Indeed, he must be watched to prevent his wasting them.

All disputes with the contractor as to the quality of the materials are eliminated.

Because of the larger volume of materials in which it deals, the state can usually secure lower prices per unit than can the individual contractor.

The contractor will insist, of course, on prompt deliveries. He will be much more critical in this respect than if he were doing the purchasing himself and he may make claims for damages due to faulty deliveries but the state should and can operate better than the contractor in this respect.

It costs something to handle the business end, of course, for purchasing agents and clerical people to buy and route the materials, and for this service the contractor, when he furnishes his own materials, charges from 5 to 10 per cent. of the value of the materials. This cost is reflected, necessarily, in the administrative costs of the state highway department and there is much bother connected with the supply of materials to the contractor. The advantages, however, seem to outweigh the disadvantages.

Testing of Materials

So much costly paving is involved in modern state highway construction that the testing of the materials used becomes an important division of the work.

The geological work and the testing may be combined in one department without difficulty and a highly trained geologist may be placed in charge of both branches of the work.

It is hardly possible to make up cost estimates until the sources of supply of the materials are known and the geologist and the testing engineer often settle the matter for the engineer.

After construction work begins it is necessary to know how the concrete mixtures, asphaltic and Portland cement, are working in order to get the best results, since, although the ingredients have all passed the specifications satisfactorily, the limitations of the specifications for the combinations nearly always permit some latitude.

Also, it is interesting to know, for instance, the compressive strength of the concrete in the pavement slab after the road is completed.

A testing laboratory can be set up at no great cost, probably in no case exceeding $10,000, which will do all the testing required in the general line of work.

The United States Bureau of Public Roads requires the tests to be made and it seems to be advantageous to have the work done as a state highway department matter rather than to rely on private firms of testing engineers.

LOT AND BLOCK PLANNING IN RESIDENTIAL DISTRICTS

By Arthur C. Comey, City Planner, Cambridge, Mass.

It is to be assumed that in the normal case a proper layout of main streets and disposition of public grounds will permit the minor streets to be so arranged as to produce the optimum in block lengths and widths, the latter closely affecting lot depths. Lot widths, on the other hand, are not controlled to any large degree by other elements in the plan and may, of course, readily be changed at any subsequent time prior to development or actual sales without materially modifying its general relations, said Mr. Comey in his recent address at Ottawa, Ontario, at the joint meeting of the Town Planning Institute of Canada and the American City Planning Institute.

Factors Controlling Width

The factors controlling the width of interior lots are, on the one had, adequate width for the dwelling itself, light and air in its yards and (to a less degree) passage for automobiles; on the other, the cost of utilities in the street, which rise rapidly as lot widths are increased and practically require the minimum adequate width to be the standard, if not the maximum as well, except as topography and other elements in the plan fix certain points and permit somewhat larger lots without increased expense. A house nearly square is the most economical, so that, except where under the spur of high land values lots have been plotted too narrow, the two-room-deep house is the usual type.

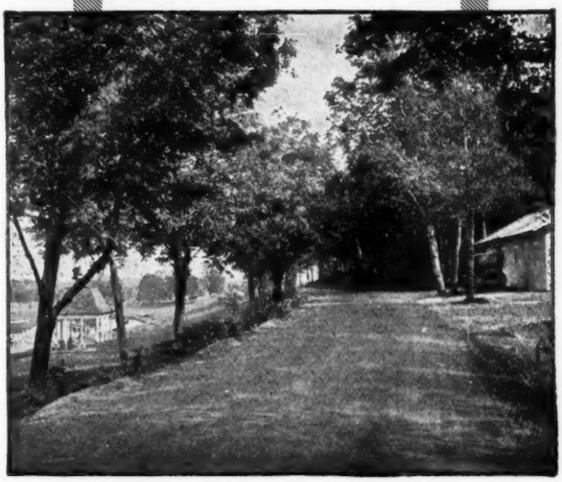
For detached houses, 7 or 8 ft. is the minimum side yard width to assure sufficient light and air at the first story, as well as safety from fire. One side yard should be at least 10 ft. wide to provide space to drive an automobile. The square house is probably the widest that should normally be provided for. The 6-room house may be as small as 22 ft. square, the 7 and 8-room types running up to 26 or 27 ft. The proper standard minimum lot width for detached houses is 40 to 44 ft. Unless 40 ft. can be obtained, semi-detached or row houses should be planned.

For semi-detached houses, 10 ft. is none too wide a side yard for light and air as well as for the passage of automobiles. Such houses need not be over 23 ft. wide and are frequently not over 20 ft. The proper standard minimum lot width for semi-detached houses is 30 to 33 ft. In sections with moderate rentals it is proper to mix detached and semi-detached houses according to any scheme of grouping the city planner and architect may work out. Each pair of semi-detached houses requires 1½ lots of a size suitable for detached houses. In cases, therefore, where it is desirable to plat lots in advance of building, the 40-ft. width, or better, 44 ft. may be used as a standard minimum.

Mingling of Types Undesirable

Three reasons prevent the advantageous mingling of row houses with the other two types: An alley is usually required behind the row house, a considerable expense, which constitutes an unnecessary burden if incurred behind houses with side yards and therefore not dependent on alleys; the larger building units are apt to be out of scale with the other types; and in most cases the type of occupancy is different. The row of three houses placed at intersecting streets may be used with semi-detached and detached houses by adding to the rear yard of the middle house an extension 10 to 20 ft. wide, reaching the side street across the rear of the corner lot. The unit of three will require about two lots of the size for detached houses, and therefore fits into a scheme of 40 to 44-ft. lots.

The row house attains practically its full economy with 5, 6 or 7 in a group. Above 9 the inordinate length of the row becomes unpleasant architecturally, and at the same time increases fire risk and steadily decreases venti-



Three different sections of Marquette-Negaunee Road, Marquette County, Mich. These roads were waterbound macadam treated with "Tarvia-B" in 1917 and 1918. This is the main line of travel between the busy mining cities of Ishpeming and Negaunee, Mich. A traffic census revealed the passage over this road of 1980 vehicles per hour, the majority of which were automobiles.

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Like many roads built in this country a few years ago, this Marquette-Negaunee road was plain waterbound macadam construction. But after it had been in use for a while the road authorities of Marquette County discovered that plain macadam would not stand up under the torture of modern traffic.

The road authorities had to find some way to save their road, which is an important main highway carrying heavy traffic. They turned to Tarvia as the surest and most economical solution of the problem.

They treated the road surface with "Tarvia-B" in 1917. In some places where the wear had been particularly severe a second treatment was applied in the summer of 1918.

Today, instead of a ruined macadam road which would soon have to be rebuilt at great expense, Marquette County has one of the finest stretches of road in all Michigan, as the photographs show.

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lation in the block. Such relatively short groups obviously require special lotting. The lot widths for interior houses are controlled absolutely by the design of the house. To secure adequate light and air, row houses should not be more than two rooms deep. The usual plan is one large room across the front and one or two smaller rooms at the back. The proper width for such a house is 18 or 20 ft. The end houses of rows may be put on lots 27 to 30 ft. wide, so that two such end houses of adjacent groups require three of the lots designed for interior houses.

It is difficult to make a lotting scheme which will serve for both row houses and for semi-detached and detached houses. In cases where row houses are anticipated, lotting should accompany the plan for grouping the dwellings instead of preceeding it.

Expense is in Frontage

While it is generally recognized that 50 ft. is sufficient distance for light and air between the fronts of small houses, and while this same distance is also a sufficient minimum between backs, in practice such shallow lots as these dimensions produce are seldom found necessary owing to the fact that added lot depth does not correspondingly increase the cost of most utilities. It is frontage that is expensive, and rear land must be considered to remain close to the acreage cost of raw land. This is a particularly important factor where topographical conditions or irregular boundaries would involve considerable extra length of streets to produce but few more lots of standard depth, the alternative of fewer and deeper lots with much less street construction being much cheaper and involving only a slight loss in gross selling value.

On all except the main thoroughfares, the needs of traffic are not sufficient to affect the distance between the fronts of houses. In detached house neighborhoods, experience indicates that 20-ft. front yards are not excessive. For semi-detached houses, 15 ft. is found suitable. For row houses, 10 to 15 ft. may usually be provided. A variation in set back not exceeding 5 ft. usually adds to the attractiveness of the street. Unnecessary depth runs up the cost of service lines from the utilities that are placed in the street. If the street lines were placed at the building line, as in Washington, D. C., the utility lines might be run close to the houses, thereby saving considerable expenditure necessary under any of the present methods.

Houses of moderate price normally range from 18 to 32 ft. in depth, the vast majority being from 20 to 30 ft. deep, though certain designs for narrow semi-detached houses may require 34 to 35 ft. In the depth of rear yards even more variation occurs, both because their use varies and because it frequently proves to add so little to the cost to make them ample. For detached houses, an ample garden space for a person working elsewhere during the day is 40 by 50 ft. If not so used, this is still not too large for children's play.

On streets of ordinary width, lots for detached houses should normally be planned 90 to 110 ft. deep; for semi-detached houses, 80 to 100 ft.; and for row houses, 70 to 90 ft., including to the center of alleys where introduced.

Where extreme land values do not preclude, a scheme of lots based on a standard minimum of 40 to 44 ft. by 90 to 100 ft. is proper. In extreme cases, where row houses are certain to come, lots as small as 16 to 18 ft. by 70 ft. may be necessary, but intermediate widths so common in most of our cities are not easily adapted to modern housing standards.

Corners are Special Problems

The best size for corner lots in cases where practically all the houses are to face one set of roughly parallel streets may be fixed as ranging from the same width to 5 ft. wider than corresponding interior lots, and approximately the same depth.

With houses fronting on all streets, to secure the maximum salable frontage and the least interruption to the architectural motive along each street and around the corner, the corner lot is best made approximately square. It should be equal in area to the corresponding interior lots. A somewhat large square corner lot may be cut diagonally in two, and a pair of semi-detached houses set across it, though this expedient is not always pleasant. It is not apt to be a good plan to attempt to crowd houses at a street intersection and still give sufficient square feet of rear yard space by violent skewing or irregularity in lot boundaries. Acute interior lot corners should be particularly avoided. Lot lines should usually be run back at least 40 ft. to a point not less than 5 ft. behind the house, approximately at right angles to the street.

Block widths are normally twice lot depths, though many irregular blocks are bound to be platted, especially in layouts on rough or peculiarly shaped land, to economize in construction cost and in land used for streets.

Block lengths are controlled by the needs of traffic, both vehicular and pedestrian, and by factors of safety. Experience shows that in residential areas, blocks 600 to 700 ft. long cause little dissatisfaction. Shorter blocks are wasteful of land in cross streets. Blocks longer than 800 ft. are found to cause undue detours in going from one side to the other. This is more noticeable in the case of foot traffic than the modern automobile. Inasmuch as adequate footways require but one-sixth the space of cross streets, and even less proportionate construction cost, their use midway across blocks of lengths up to 1,200 ft. is permissible, particularly in districts with steep slopes, making connecting streets expensive. In areas designed with deep courts and blind streets only partially cutting up the blocks, if each such court and street has a path leading from it across the block, most of its disadvantages will disappear, though it will still be less easily policed or protected in case of fire than regular blocks.

While variations to the ordinary block and lot system which do not easily conform to rule have hitherto seldom been laid out, the increased attractiveness attending their use in a reasonable number of instances demands that the opportunity be not closed by rigid standards. As they are apt to be integral parts of the group designs for the actual houses, their layout cannot be determined until the building program is adopted. Where interesting variations are not anticipated, the minimum standard of blocks, 180 to 200 ft. by 600 to 800 ft., with lots 40 to 44 ft. wide, is more apt than any other to be adapted to the future needs of a neighborhood.

WATER WORKS SECTION

WATER WORKS IN 1865 AND IN 1920

By John W. Hill, Consulting Engineer, First National Bank Bldg., Cincinnati, Ohio

Water Works in 1865

When the Civil War closed (1865) there were in the United States about 150 cities and villages having works for public water supply, and many of these furnished water under very low pressure. At that time there were no public water works in the states of Maine, North and South Carolina, Florida, Mississippi, Texas, Arkansas, Iowa, Wisconsin, Nebraska, Minnesota and Nevada; twelve states in 1865 without a single public water works.

Pumping works were confined mostly to the large cities while many of the smaller cities and villages developed nearby gravity sources. The cities of Columbus, Dayton and Toledo in Ohio; Indianapolis, Terre Haute and Evansville in Indiana; Covington, Newport and Lexington in Kentucky; Knoxville, Nashville and Memphis in Tennessee, and Peoria, Springfield and Bloomington in Illinois, had no public water works at all. This also was true of other cities not mentioned. A public water supply was a luxury not thought of by many populous cities in 1865, and no one at that time was specializing in water works machinery and equipment. Stop valves and fire hydrants were usually made by the city using them and large pumping engines were of special design and seldom duplicated.

One gravity works in an eastern state made no direct charge for water to its 40 consumers, assessing the small cost of maintenance each year upon all the takers instead.

Following the Civil War with its previously unheard of profits to merchants and manufacturers, huge fortunes made from army contracts and flotation of government bonds, extraordinary expansion of the currency, and other financial conditions, which we are again experiencing after a lapse of 55 years, came an era of municipal improvements including water works, gas works, street cars, pavements, handsome and commodious public buildings, street lighting and other things which then were luxuries and now are necessities according to our mode of living. Previous to that date (excepting the city of Cincinnati) fire protection was mainly obtained by buckets and hand fire pumping engines taking water from large cisterns constructed in the streets or from fire hydrants furnishing water at low pressure. Prior to the Civil War a few cities other than Cincinnati had steam fire engines of Cincinnati manufacture.

The Holly System

The cost of pumping water works with specially designed machinery was prohibitive in all but the larger cities, and not until Birdsall Holly of Lockport, N. Y., offered his rotary pump for fire service and quadruplex piston pumping engine for domestic service, was there anything in the market especially adapted to water works for the smaller cities.

The Holly system, as all know, consisted of pumping directly into the mains without the intervention of standpipes or reservoirs, the pumps running at a widely varying speed according to consumption. The Holly system gave the initial impetus to water works construction in the early years following the Civil War, and soon had many imitators. The essence of the system was an automatic pump regulator actuated by the pressure in the discharge main.

The same thing that happened in water works development and expansion after the Civil War, will happen again, within a few years, when municipal finances again are normal and funds are available for the many improvements and extensions now needed. Few cities are now fully abreast of their water works requirements, the great majority are behind in all respects, and few improvements are now being made excepting where funds were provided before our entrance into the World War. Some work is progressing in those cities in which improvements depend upon the surplus from water rent, but in all instances where funds are to be provided from municipal bond issues, there has been a marked halt during the past three years. In the words of Dr. Munyon "there is hope" for city water works improvements in the near future.

To those who are alarmed at the present high prices of water works materials, it is well to remark that in 1869-70 cast iron water pipe sold in the Western market (bounded by the Mississippi river) at $100 per short ton, fire hydrants at $100 each, stop valves in proportion, and pumping engines of special design cost as high as $15,000 to $20,000 per million gallons daily capacity.

Delayed Improvements

During the past two or three years many water works have stood still in the matter of improvements and extensions, for lack of money to carry out the projects necessary to keep the works abreast or in advance of real requirements. New or additional pumping engines, boilers, stokers, heaters, feed pumps, extension of distribution mains, increased capacity of supply mains, additional storage, modern and adequate systems of water purification, and other details, are among the things that water works managers and cities need to bring their works up-to-date.

During the past two summers, some cities have been threatened with, or actually had water famines, from inadequate or run down pumping equipment, or for lack of proper mains to supply and distribute the water. Some although provided with filtration and chlorination works have been required to warn consumers to boil the water to avoid typhoid fever.

The splendid results obtained during the last 20 years in the reduced typhoid fever rates by filtration of polluted

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water supplies, is an argument which no city or water company can resist, and the only cause of delay in the universal adoption of the most efficient methods of water purification, and the complete elimination of typhoid fever so far as a polluted water is the carrier of the germ, is the lack of money. Every works must supply some kind of water for manufacturing, commercial and sanitary purposes, and for fire protection, even though it may not be fit to drink, and water purification, therefore, under present practice becomes the last step. It should not be so, for life and health are the most important things to conserve in a public water supply.

Many writers have proven from official statistics, the money value to a person and the community at large, of a public water supply free at all times from typhoid taint, and this has been done to show the public and those responsible for a public water supply, that even considering human beings as a collection of animals, or to put it more plainly, as a bunch of horses, cattle, and hogs, it will pay to furnish them with a drinking water that cannot possibly lay the foundation for typhoid fever.

This argument appeals only to the sordid side of life; but surely there is something higher and nobler in preserving a human being from disease and death, than the money value he may be to his family, and the community of which he is a member. It should not be necessary to put the humanitarian value of a pure water supply into dollars and cents to convince the city or water company that a drinking water should be always wholesome as a matter of simple justice to its users.

The advance in the refinements of water purification by the use of bleaching powder, (hypo-chlorite of lime), liquid or gaseous chlorine, direct oxidation of organic matter by electro-chemical process, and the ultra-violet rays, are of recent birth in their practical application, and time will be required to determine the best method of treatment after filtration, if the water is of surface origin.

Ground waters though otherwise satisfactory, will sometimes require treatment to render them safe for drinking purposes and the advanced methods of water treatment will here apply. Where ground water is the only available source of public supply and this (as usual) contains high parts of lime and magnesia, water softening apparatus is sometimes used to "break" the water and make it more acceptable for laundry and bath purposes. The softening process is also a purifier of bacteria, but even with a naturally pure hard water it is desirable to render the water soft for domestic and many commercial purposes.

Some water works have filtration systems too antiquated for present use, or of insufficient capacity, and these will require modern methods of filtration or enlargement of the works to provide a safe and ample capacity for the present and future.

Water Rates

Public Utility Rates cannot be kept down when the cost of all labor and materials entering into the maintenance and operation of the utility are steadily rising. A water rate established by ordinance 20 or 30 years ago, or even 10 years ago, when cast iron pipe could be bought at $25 to $30 per ton, lead at 4 cts. per pound, common labor be had at $1.50 per day, and other things in proportion, whether the service be furnished by a municipal or a private corporation, cannot fit the prevailing costs of all labor and materials. A municipal corporation may be able for a time to maintain the ordinance rates by carrying a floating debt, and issuing short time notes, but some day the obligations must be liquidated from earnings, and excepting there be a sharp reaction in the costs of labor and materials, the rates must be increased in order to meet the current expenses, and interest and sinking fund charges on bonded indebtedness. The latter was established years ago when bonds were issued, and before the era of high cost created by the World War, and is not affected by the conditions complained of, and it may be said the property value is no more than the capital actually and honestly invested in the works, although as shown by the recent railway investigation at Washington the reproduction cost today may be 50 per cent. more than real cost as represented by bonds and investment from earnings of a municipal works, or by stock and bonds of a company works. Of course, interest and redemption charges are not being paid to holders of securities on the inflated or speculative values of the properties as of today but on the values as represented by obligations issued, generally years ago, and before the rapid rise in cost of labor and materials.

Labor and materials, however, required for maintenance and operation are now higher than they have been for over 30 years, and the increased cost must be met from income from service to the public. This is true of all public utilities, and many increases have been allowed and sanctioned by State Railroad and Public Utility Commissions, in order that the Public Utilities operated under franchises may not be forced into bankruptcy or receiverships. Federal receiverships will provide rates sufficient to pay all operating charges including absolutely necessary extensions and improvements, interest on bonded indebtedness and create a reasonable depreciation fund.

A municipal corporation can raise the water rates at any time by ordinance of council or the city commission, and while the consumers can, and always do, complain at higher rates for water, gas, electric current, and trolley fares, in the language of the Arabian Nights "there is no help for it" excepting a return to the good old conditions of public utilities prior to the World War.

Water Meters

Water meters were scarcely known in 1865. Before that date the existing water works supplied the consumers under what we know as flat rates, and one works at least in an Eastern State made no charge whatever, to its consumers, the small expense of maintaining the service was assessed per annum, pro rata on the 40 water takers. This was a gravity works, and the annual cost of maintenance was small.

The modern water meter has had a large influence on the cost of operation, perhaps quite as much as the high duty pumping engine, and the two have been the factors in reducing the cost of pumping, and in affording protection against waste of water. Invention and improvement in this case have kept pace with necessity, and the low per capita cost of public water supply in most instances is in large measure due to the liberal use of water meters.

The early water meters were heavy and cumbersome and some of them of no utility whatever. It has been stated that during the reign of the "Tweed ring" in New York about 50 years ago, the purchase of thousands of

useless water meters was one of the prolific sources of graft. Thousands of meters bought by the "ring" during its days of power, were afterwards found stacked in the basement of the City Hall, not one of which, it is said, was ever set or used.

These meters were bought at prices several times their real value, had they been useful, and their purchase was not intended to prevent waste of water but to facilitate the flow of money from the City Treasury into the pockets of the "gang" of which Wm. N. Tweed was the chief Sachem and beneficiary. The plunder of the "Ring" was enormous but in proportion a mere bagatelle to the waste and graft of the late Army contractors and their satellites, or of the unholy gains of the modern profiteers. If Mr. Tweed, Mr. Connolly, Mr. Hall and many others who shared in the New York "steal" were alive today and reading the revelations which investigating committees of Congress are making of the unnecessary and wasteful expenditures for cantonments and other war institutions, and the enormous profits of the people who are trafficking in the necessities of life, they would blush for shame and wonder why such a hullabaloo was raised about their paltry graft of a few millions, less than two generations ago. Tweed was properly punished for his shortcomings, and perhaps our dishonest War Contractors and "profiteers" will also be made to answer for their crimes in due time.

The water meter favored by Mr. Tweed was intended for a "steal" while the modern machine is intended to promote "honesty" in the accounting for water drawn from the public mains.

Private water companies have from the beginning, regarded water meters as an essential of their equipment, and it is only the municipally managed works that has ever looked with disfavor on them.

Future development will largely increase the use of water meters, until generally water will be furnished and charged only by reasonably exact measure, for the meter is not a "balance" or instrument of precision, and with constant use, and sometimes with no use at all, when connected in a line of service pipe, the original so-called accuracy of the meter will change, always however, in favor of the consumer. The wear and increasing "slip" of the meter will represent a larger volume of water passed than that indicated by the register, and the instances are not few where a water meter has altogether ceased to register the flow while the normal amount of water was going through it, the consumer having no knowledge of trouble in the meter.

Ownership of Water Works

Since the advent of the world war, there have been few or no appraisals of public utilities for purpose of sale to municipalities, but many for rate adjustment, made necessary by the increased cost of labor and materials due to war conditions. It is not probable that there will be many sales of water works to municipal corporations for some time to come. The unfortunate financial experience of the federal government in the operation of the railroads has put a crimp in the mania for municipal ownership and operation of public utilities, and it will require a few years, at least, to convince an intelligent and thinking public that water works, gas works, electric lighting works and trolley lines can be better administered by

24-inch line looking south from Dam, through Medicine Canyon.

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professional politicians, than by trained business and technical men who have devoted their active lives to the study of, and experience with, problems entering into the construction and operation of public utilities.

The construction and maintenance of streets, roads and bridges, of sewers and sewage disposal works, the exercise of police powers and fire protection, are properly public functions because none of these things can be properly bartered to a private corporation under a municipal franchise. There are a very few instances where cities have granted franchises for the construction and operation of sewers, but none that have worked successfully, even though connection with and use of the sewers was compulsory. Sewers, and street lighting (which is part of our police regulations), can best be managed by the municipal corporation in the interest of the people as a whole, but the electric current or gas for street lighting, should be purchased under contract from some one who is concerned in making the commodity for general use, as a rule only a small part of which is taken for strictly public purposes.

Bridges in some instances in the distant past, have been constructed and are now maintained and operated under public franchises, but generally speaking, a bridge is a part of a highway and highways are properly part of the municipal or county *ensemble*.

It would be difficult, excepting by taxation, to fix the price each property owner or citizen should pay for such construction and maintenance of highways, bridges, sewers, street lighting, and police and fire protection, because all these are not susceptible of measure to the individual like water, gas, electric current and rides on the street cars; they confer general benefits, the cost and use of which should be shared by all.

This, however, is not the case with respect to water, gas, electric current and trolley rides, which the individual can use according to desire or necessity and pay for by measure.

Assuming that the rage for municipal ownership of public water works is not now rampant the appraisals in the near future will be for "rate making" and the rules generally laid down by the State Public Utilities Commissions and by the courts, will have weight in forming a correct judgment upon the value of these properties. In making the inventory of tangible property many articles will always be found which have been set aside temporarily and which would have no value in the opinion of a buyer, and yet in the mind of an owner would have a possible value, such as pumps, boilers, gas exhausters, air compressors and other details which at the time of appraisal are in the discard, although such details are often overhauled and restored to useful service. If, however, such articles are worn out and no longer "used" or "useful" in the works of which at one time they formed a part, it is fair to assume they have been "amortized" in the depreciation fund, and if this has not been done by the owner, the U. S. Supreme Court in the Knoxville Water Co. case has stated the "fault is its (his) own." In any event if the thing is not now "useful" it should be excluded from the inventory.

HOW TO CONDUCT BOND CAMPAIGNS FOR MUNICIPAL IMPROVEMENTS

By Robert E. McDonnell, of Burns & McDonnell, Consulting Engineers, Interstate Bldg., Kansas City, Mo.

Many engineers of experience and ability prepare and present plans and lengthy reports covering needed municipal improvements. These reports are often marvels from an engineering standpoint and represent months of study and investigation of every phase of the question.

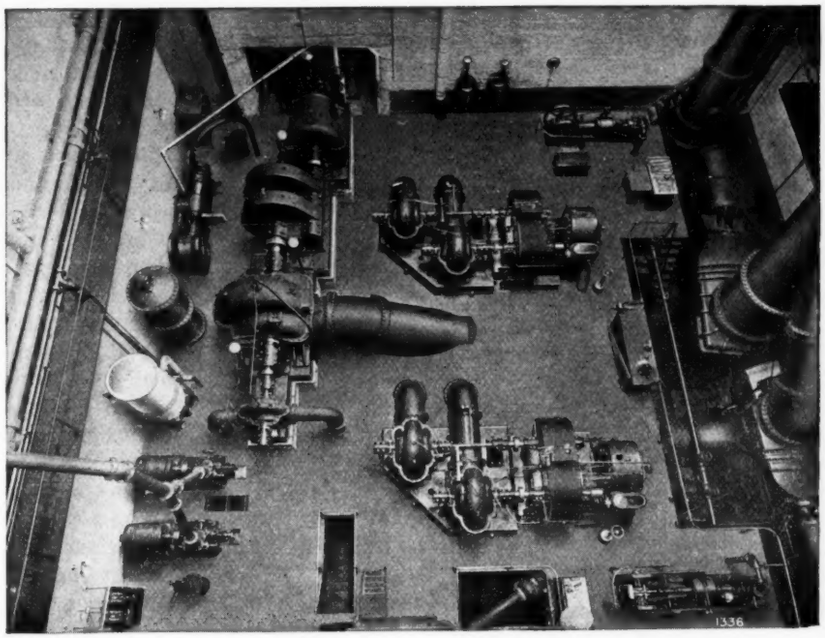
One report recently was brought to the attention of the writer covering a six months' investigation of the available water supplies of a Western city. The report was a voluminous document of over 600 pages with 33 pages covering table of contents and 15 pages devoted to a list of references. The climax, summary and recommendations on the last page occupied less than twenty lines and was the only part of the document that interested 99.99 per cent. of the voters, who paid for the report. This percentage is arrived at by assuming there is one engineer to every 10,000 people in a community, and it is absolutely safe to assume that the engineer is the only person in the 10,000 who will read the report, and he who does read the report, shows by doing so that he belongs to the class of either out of a job or a paid reviewer.

Reports Too Technical

Most engineers' reports like this one are really prepared with the ultimate object in view of a bond issue for the improvements, yet to read one through, which is never done, one would think they were written to impress the laymen with the technical training of the author. In this same Western city a heated controversy is now raging as to what should be done about the future water supply. The report tells what should be done, but not in a way that is readily grasped and understood by the 99.99 per cent. of the people. The engineers who prepare fine, readable reports are only doing a small part of their work, the real value of an engineer's service to the public comes in presenting his subject so clearly to the voters that everyone will see it, understand it, talk it and VOTE for it.

The Illustrated Bond Campaign

Many worthy projects are never brought to a vote and many equally worthy ones are voted down merely because the engineer failed to properly illustrate the various features. In your own experience, how many times have you, as an official, known to your own satisfaction the need of a bond issue for water, light or sewer improvements, yet you hesitate merely because the public does not possess the same knowledge as you possess regarding the improvement? You cannot go out and individually talk and convince every one of your friends of the need of the improvement, but the illustrated bond campaign does this for you. Only recently a conference with some Iowa city officials disclosed a polluted water supply and an inefficient lighting plant. The Mayor remarked: "We know the needs of the plants and have voted AT it, but met defeat three times." The defeat of worthy projects is invariably due to two causes—poorly presented and not understood or lack of confidence in the administration. In the Iowa case it was poorly presented but, following a three weeks' campaign, wherein every phase of the project



Filtration Pumping Station, City of St. Louis, showing two class "A" units, 40 million gallon capacity, and the new unit of 100 million gallon pump, all pumping against 60 ft. head.

Repeat Orders for De Laval Pumps

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This has happened at Cleveland. Toronto, Philadelphia, Indianapolis, etc.

Some years ago the City of St. Louis bought two De Laval pumps of a combined capacity of 30,000,000 gallons, driven by single-stage geared turbines, as shown in the above photograph. Recently greater capacity was required, and the De Laval 100,000,000 gallons per day geared steam-turbine-driven centrifugal pumping unit, shown at the left side of the picture, was purchased. The circulating pump for this unit is coupled directly to the main pump shaft.

All of these pumps discharge against 60 ft. head.

The tremendous saving in cost of buildings and foundations resulting from the use of centrifugal pumping machinery in this plant is apparent. The super-structure need not be high nor heavy, as only comparatively light parts have to be lifted by cranes.

The steam economy of De Laval turbine-driven centrifugal pumps is equally as remarkable as the saving in first cost. State your conditions fully, and estimates upon which we are prepared to base guarantees will be given.

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515 Johnson Avenue **TRENTON, N. J.**

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was illustrated, the improvements were almost unanimously authorized.

Pictures

Pictures are plainer than print—they present pertinent points only. They are in the language the people know and understand. Photographs of inefficient machinery and its cost of operation are shown by stereopticon slides, followed by one showing EFFICIENT equipment and the saving in operation costs. Alleys showing outhouses, garbage piles, ash heaps, etc., make good illustrations of the lack of sewers and sanitation and contrast this with stereopticon slides showing abandonment of alleys with the installation of sewers, with its beautiful back-yard flower beds and creek banks beautified.

Use of Vital Statistics

Health statistics graphically shown on a slide of your own city, even showing poor results and you are ashamed of them, serve to stimulate an interest in bettering the conditions. Slides showing the typhoid rates of other cities with pure water supplies emphasize the need of action in your own city. Typhoid and many other water-borne diseases are preventable diseases, preventable by proper precaution in water supply, food and sanitation.

The time is fast coming when the sheriff and police officers will investigate and fix the responsibility for every case of preventable disease. Doctor Hazen, an authority, says for every case of typhoid someone ought to be hanged. The real town booster gains nothing by covering up and minimizing the town's sore, festering and ugly spots, but let them be known and the town will soon have none of these to apologize for.

Slides and Moving Pictures

Proper publicity and presenting of engineering reports needs no exaggeration to make the argument effective, but a real portrayal of plain facts by slides and moving pictures merely brings to the attention the need of improvements, and where the necessity is shown, the cash is always forthcoming.

During a campaign for sewers and a modern sewage disposal plant, recently, the writer found the moving picture shows all anxious and willing to show such films as "The Daily Life of a Fly;" also, the public meetings were packed to see the plans and estimates shown on the screen, illustrating the proposed improvements, together with pictures showing the best examples of similar improvements in other cities.

There is no municipal improvement that cannot be graphically illustrated by pictures and diagrams and they are plainer than printing or typewriting. Maps showing water or sewer lines, with their sizes and locations, can be shown by slide. White-way or ornamental lighting can be well illustrated. The writer has conducted successful campaigns for bonds by this method, covering such a variety of subjects as the following: Campaigns for municipal ownership of water works and lighting, for sewers and sewage disposal plants—new water supplies, filtration systems, water power, park and street improvements.

Fear of the People

It is an unfortunate fact that many a needed public improvement is delayed to the point of criminal negligence on the part of those in authority, solely on account of their fear that public sentiment may be against the improvement.

The superintendent of the city water works may know that the water supply is inadequate or that the pumping machinery is insufficient to give fire protection, and he may confide this alarming situation to the other city officials, only to be told to keep the matter hushed up, as they do not dare ask the people to vote bonds until after the spring election, and they will try to pinch along another season on their present equipment. They are willing to gamble against Fate. They take a chance, and sometimes they lose, or, rather the public loses property worth many times what the water works improvements would have cost; and that is not all—the public then awakens to the necessity and rebuilds its water plant—and if justice falls where due, the public also selects new city officials. But this illustration pertains only to property loss—material things. I have in mind a far worse negligence—criminal, without a doubt, but wholly due to the fear of taking the public into the confidence of those responsible for public property. This is a case where a city is supplied with pure water, but the plant facilities are not adequate to meet the requirements of the dry season, and as a consequence of this condition of affairs it becomes necessary to introduce polluted water into the city mains at times during the hot summer season. The superintendent of this water works system told me he was simply "up against it" and he did not dare mention the true situation publicly for fear of the storm of indignation that would fall upon him. And yet this city failed to vote bonds for an increased pure water supply when the question was submitted to a vote. The reason it failed was plainly due to the fact that the city officials did not have any definite plan prepared to show how they proposed to use the money, nor did they make any organized campaign to educate the public to the necessity of the improvement.

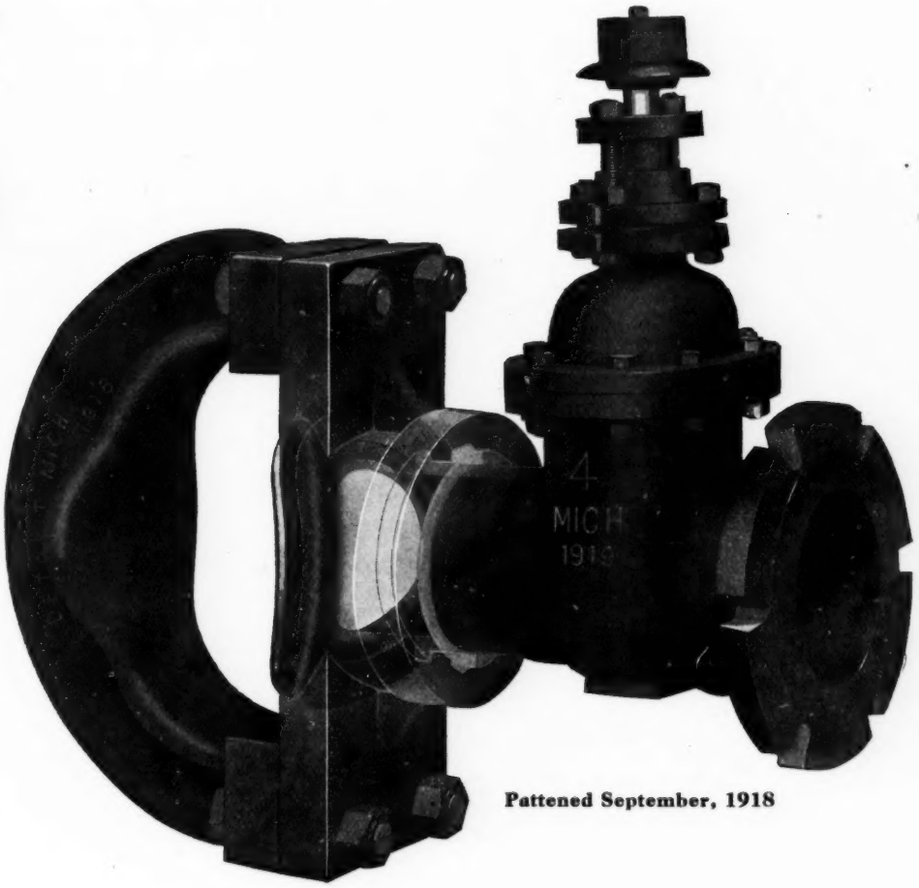
The average engineer's report on improvements is too long, dry and technical and frequently leaves the officials in the air as to what to do next. The real job of raising the funds is as much the engineer's obligation as showing how much is needed.

Call an Engineer Early

Many municipalities make the mistake of proceeding with a bond issue without first having an experienced engineer's report covering cost, comparison of various features and recommendation about the project, with the result that when voters are asked for bonds, the questions the voters ask about the project cannot be intelligently answered and the officials are put in a defensive position and the voters are groping in the dark as to some phases of the question. Then again, the cost, or amount of bonds, will be questioned unless it is based on a very carefully made plan and estimate.

A wrong impression or conception of a project often defeats it. The voters have a right to know and should know every detail of the project before voting.

The correct cost and proper explanation of the project, or the first impression of it, is the lasting one, and this should be given at the outset and not after there are hundreds of half-baked opinions spread broadcast regarding the projects. An engineer's greatest value to the community comes in by properly conceiving the character and extent of the work before a bond election and, like the skilled diagnostician in studying the symptoms, the causes, etc., he can prescribe correct treatment before mistakes are made. Cities often fail to realize that it costs no more



Pattened September, 1918

Get the Facts on this Sleeve

The new Flower sleeve has saved time, money and labor in making taps the country over. Engineers everywhere have quickly recognized its value.

If you haven't had details of this improved sleeve with the "built-in" lead, send for it at once. We want to have a copy of the sleeve data sheet in every engineer's files.

Flower Valve Manufacturing Co.

117 Parkinson Street **Detroit, Michigan**

(24)

In writing to advertisers please mention MUNICIPAL AND COUNTY ENGINEERING

for an engineer's services right at the outset than it does to call him in after funds are provided.

An improvement that may apparently seem dry and uninteresting can in this way be made such a live, interesting subject that civic organizations, women's clubs, labor unions, etc., are seeking an illustrated talk before their organizations, which not only instructs, but entertains. How many people nowadays would go to hear a paper read or a lecture, even if ably presented? The public likes to see as well as hear, and to see by slides what their neighboring cities are doing helps to do better our own problems.

Graphic Presentation

This method, of course, involves much added work for the engineer, but it is worth while, at least in the satisfaction that comes from a consciousness of a public duty discharged to the best of one's ability. A study of this subject has led us to adopt the graphical method of presenting everything that can be pictured. The results have been gratifying and show that in the last two years thirty projects have been handled in this manner without a single bond defeat, although ten of the projects had previously met defeat before the illustrated bond campaign had been applied. However, the greatest result of all comes in the fact of a better citizenship, a lessening of the general and typhoid death rate through better water supplies or sewerage, an awakened civic pride and increased trade flowing to the cities that have made their public improvements models in efficiency and service to the public.

The foregoing address by Mr. McDonnell was delivered before the eighth annual meeting of the Kansas League of Municipalities.

THE PIECE-WORK SYSTEM IN METER READING

By J. A. A. Beaudin of the Montreal Light, Heat and Power Co., Montreal, Canada.

The service of public utilities involves the performance of numerous routine operations in the consumer's home by various categories of employees operating individually and without supervision, said Mr. Beaudin in addressing the Canadian Gas Association recently.

The reading of meters in situ, the delivery of bills and collection notices, and the collection of arrears are a few of these operations.

Until recent years, and even nowadays, the general practice has been to remunerate employees engaged in these various tasks on a flat or fixed rate salary, based either on the hour, day, week or month, with additional privileges (in many cases) respecting sickness, holidays, etc.

Salaried Worker Leaves No Residue

This mode of remuneration makes possible the payment of wages for labor which has been only partially supplied, and since the actual supervision of his work is impracticable, the employee is tempted to take advantage of this condition occasionally, if not regularly, to limit his activities, and the means he may use to conceal his shortcomings are only limited by his ingenuity and his morality.

Furthermore, an employee working under this system of remuneration is inclined to complete indiscriminately each task as he encounters, without any regard whatever to the amount of time and expense involved—i. e., he will often devote an unwarranted amount of time to straightening out a difficulty which if reported to the office could be handled much more expeditiously and economically by an expert. In other words, a worker on a fixed salary does not by-pass difficulties—he leaves no residue.

Piece-Worker Leaves a Residue

This state of affairs has led our company to devise and introduce a system of payment on a piece or commission basis as applicable to the various categories of these employees. This piece-work or commission system keeps the employee at his work, insures the full employment of his time, limits his absences from duty, prevents the payment of unearned wages, and regularizes the output—it helps get the work done regularly and systematically, but it leaves a residue.

The piece or commission worker is interested in handling a maximum of cases in a minimum of time, so naturally the tendency is to handle the straight-going jobs and by-pass difficulties whenever encountered, no matter what the employer's interest; the employee's interest is in the opposite direction, as every stop he makes to overcome difficulties limits his wages, hence while this system has removed the necessity for outdoor supervision, it has created a demand for closer indoor supervision over the work performed, and the piece-work system must be supplemented by a faithful follow-up system of by-passed jobs, without which it would prove a failure and cease to be economical and practical.

Workers Exchange Districts

The piece-work system only works advantageously in districts where the clientele is dense or semi-dense; it is not effective in districts where the clientele is scattered. The piece-worker is entitled to a supply of work commensurate with his capacity, and his work requires to be properly sorted and routed so that he may carry it on under advantageous conditions. The employer's interest also demands this in order to keep the piece-work rating at a minimum and at the same time afford the employee an opportunity of earning a fair remuneration thereunder. Failure to give proper attention to this detail would result in the establishment of a higher piece-work rating than would otherwise be necessary.

Employees of the same category should all be on an equal footing and be given equal opportunities. They should permute periodically from one district to another in order that one and all may cover each district and the entire system in a given period. All districts do not afford similar or equal opportunities and no one should be allowed to work continuously in either a good, poor or medium district, but all should have their turn in each.

Activities Cannot Be Limited

The piece-worker, although not a tracer, a trouble straightener or a worker fitted to operate in scattered districts, must be efficient and capable of discharging his duties in a competent manner and carrying to a satisfactory conclusion all work entrusted to his care. While he is quite within his rights in by-passing real difficulties and not spending his time in conducting long searches, etc., he must positively not be allowed to by-pass for trifling causes any of the work entrusted to him.

GROUND HOGS

—because they open up trenches quickly and neatly! Look them over.

A—This is the Ladder Type P & H Excavator making a ditch thru hardpan and boulders for a contractor down in Illinois. It's a powerful machine, fabricated of steel thruout, designed for sewer digging and general heavy trenching to 20 feet in depth.

B—Is a Wheel Type P & H Excavator opening the ground for a drain pipe-line. This is the outfit for pipe-line, conduit, and farm drainage excavation. Built of steel for light weight and flexibility; digs trenches 7½ feet deep to 28 inches wide.

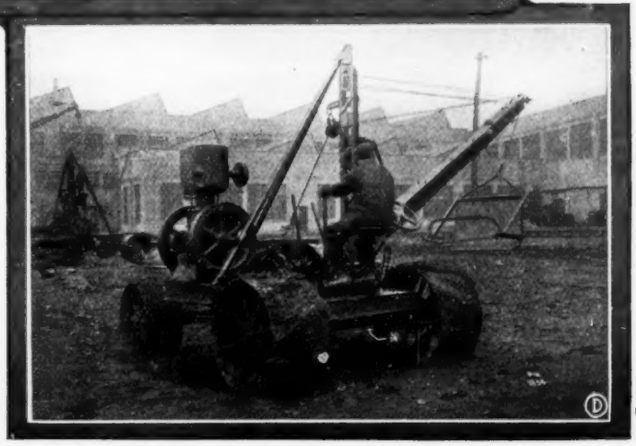
C—A machine with a multitude of uses—the 205 Dragline P & H Excavator. What it will do: Excavate open or sloping bank ditches, clean out old ditches, dig cellars and holes, strip coal, grade streets, backfill trenches, load or unload coal, crushed rock, screenings, sand or gravel, and last, but not least, it is a complete, portable locomotive crane with a lifting capacity of 3500 pounds.

D—Getting the dirt back is sometimes as troublesome and costly as getting it out. This machine makes it easy and does it in a hurry on one man's time. Just the outfit for city streets where work must be done with uniformity and dispatch. The P & H Backfiller has capacity to take care of the largest sizes of trench excavators.

You may not need P & H Excavating Equipment right now, but write for Bulletin X and keep it handy.

PAWLING & HARNISCHFEGER CO., Milwaukee, Wis.

P&H — excavators, backfillers, tampers.



It is not desirable to limit the activities of a piece-worker with a view to securing work of a higher standard, as he cannot fairly be retained in service without sufficient work to keep him employed, and even if allowed to go off duty as soon as he has performed his limited task, he will work just as hastily in order to get through and go off duty, and the employer's very object—viz., to cause him to move more slowly and perform work of a better quality, will be defeated; furthermore, the resultant limitation of his earning power is likely to cause the piece-work rating to go up. An energetic piece-worker with a large working capacity will earn "record" wages when supplied with unlimited work and will indirectly contribute to the maintenance of an economical and moderate piece-work rating. Furthermore, the employee who earns large wages will have every inclination to perform his work in accordance with instructions—his very interest in his position is the best guarantee to be wished for in this connection. A proper inside supervision over the work involved in the completion of by-passed jobs, as reported by the piece-worker from time to time, affords the employer a still further protection. This inside supervision is a most important feature of the piece-work system and must be exercised with constant vigilance..

Having now dealt with the economic aspects of the piece-work system, it may be of interest to outline briefly its operation in our company, especially as applied to our meter readers.

Saturday Devoted to "Pick-Ups"

We supply "dual service" (gas and electricity) and issue part of our bills on a bi-monthly basis and part on a monthly basis. The ordinary gas and electric lighting consumers are billed bi-monthly, while the larger consumers and all electric power users are billed monthly. Our territory is divided into meter reading districts and the work distributed in accordance with schedules, so that the readings repeat themselves on about an even calendar date in each district. Twenty-two men take care of our meter reading on a piece rating per meter. These men work five days per week on regular readings; every Saturday morning is devoted to each man "picking-up" the readings which he has passed-by for various reasons during the current week. This "picking-up" work is done at the regular rating for current readings. After the completion of this "picking-up," the residue of by-passed readings reported to the office represents only such cases as present unusual obstacles. The fact that each meter reader must appropriate a certain amount of time to "picking-up" his own by-passed readings is an added protection against by-passing for trifling causes. When reading meters in a district where the clientele is scattered, the meter readers are paid an additional flat rate sum per district; this rate varies from 50c to $2.00 per meter book. A somewhat similar system is in vogue in connection with power and special clients billed monthly, as such customers are limited in number and distributed all over the system. In addition to the regular staff two special meter readers are also employed on a combined fixed salary and piece-work basis to take care of readings by-passed by the regular readers.

STORING COAL OR SIMILAR MATERIAL BY MEANS OF SCOOP CONVEYORS

An interesting application of Scoop Conveyors for storing coal is shown in the Fig. 1, illustrating five machines being used to unload coal from hopper bottom cars direct to storage pile. Four of these machines are 12 ins. wide by 24 ft. long, the other one being 12 ins. by 20 ft.

FIG. 1. UNLOADING COAL A DISTANCE OF 150 FT. WITH FIVE SCOOP CONVEYORS.

FIG. 2. USING FOUR SCOOP CONVEYORS TO CARRY COAL FROM STORAGE PILE INTO BOILER ROOM.

REO

The Coming of the Speedwagon

It may interest you to know how Reo came to build their pneumatic tired Speedwagon in the first place.

This Reo was the pioneer of its class and type—as you already know.

It looked like a daring innovation when first announced, but we were sure of its ultimate success despite the scepticism with which it was greeted by other makers and even Reo dealers.

We had been building solid-tired trucks.

Built as well as Reo knew how, still they did not live as long as we believed they should.

One day Engineer Thomas decided to equip that chassis with pneumatic tires and watch results.

As he had anticipated, that chassis outlived the others several times over.

Repairs and replacements were reduced surprisingly.

Then we decided that pneumatic tires was the answer to trucking problems as it had long since proved to be to passenger carrying.

At first, as we have said, this new Reo which we termed the Speedwagon met with scepticism everywhere.

But it soon proved its great superiority in every way.

The greater speed of which it was capable rendered it wonderfully economical as well as vastly more efficient.

And the air cushions on which it rides cut upkeep and operation cost away down.

Now—our only problem is to make them fast enough—never have been able to catch up with the tremendous demand.

Reo Motor Car Company
Lansing, Michigan

"The Gold Standard of Values"

Each is equipped with its own electric motor and can be operated singly if desired.

These machines provide a convenient, efficient and flexible arrangement. The first machine is practically self-feeding from the hopper doors of the car and the other four may be swung around at any angle to cover a wide storage area. Five machines arranged in this manner can be operated by one or two men. They can also be used to convey the coal direct from storage pile into boiler room. Fig. 2 shows four machines being employed in this manner. Where desired, one machine can be used to load an electric storage battery truck to convey the coal directly into the boiler room as shown in Fig. 3.

FIG. 3. LOADING COAL HOPPER ON A HUNT ELECTRIC STORAGE BATTERY TRUCK WITH A SCOOP CONVEYOR.

The advantages of using several 20 ft. or 24 ft. long conveyors are quite obvious. One long conveyor would not be equally as portable. It would be more difficult to adjust and handle and the shorter units can always be used to better advantage for general work about the plant.

A great advantage of using the Scoop Conveyor to unload hopper bottom cars is the fact that no track hopper or pit is necessary. This makes it possible to unload cars at any point along the track. To unload cars, the Scoop or feed end of the machine is placed near or under the car hopper. The hopper door is then released and the belt on the Scoop Conveyor carries the material away as fast as it flows through the hopper opening.

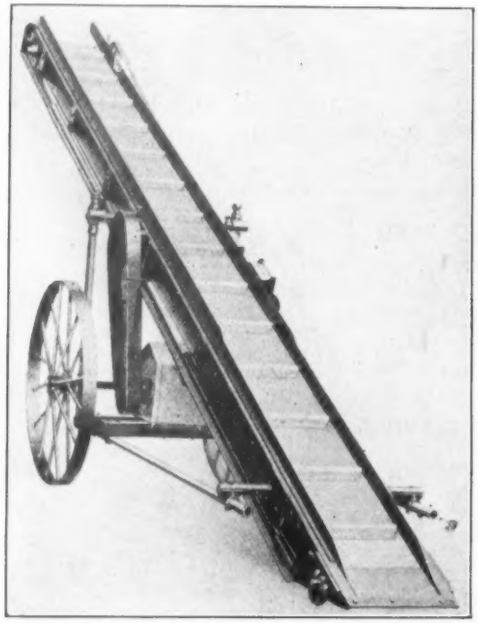


FIG. 4. SCOOP CONVEYOR FITTED WITH HIGH FLIGHT BELT.

Fig. 4 clearly shows the construction details of the Scoop Conveyor which has been previously described in the technical press. For further information, address the manufacturers, The Portable Machinery Co., Passaic, N. J.

REMOVING A CONCRETE BRIDGE BY BLASTING

An Iowa board of county road commissioners wished to demolish a concrete bridge in a short time so they employed a blaster to remove it by means of explosives. His procedure was as follows:

With an ordinary stone drill, he drilled ten holes 3½ ft. apart and extending about two-thirds through the end walls or abutments. These walls were about 3 ft. thick.

Into each hole, he packed a pound of straight N. G. 60 per cent. dynamite. An electric blasting cap was imbedded in each charge. The holes were well tamped with moist clay. They were placed just about the water level.

Holes were dug in the earth located at each of the four corners of the abutments, in each of which were loaded 5 lbs. of the same grade of dynamite. These charges were packed compactly up against the wall at its most vulnerable point. These charges were also well tamped in with clay. Another 5-lb. charge was placed down under the center of the two abutments about half way between the corner charges.

The floor of the bridge was of reinforced concrete. Four charges were placed at intervals on top of the floor. These were covered with thick mudcaps packed as compactly as possible over the dynamite. Directly under the charges on top of the floor were placed three 5-lb. charges. These charges were held in place with clay mudcaps.

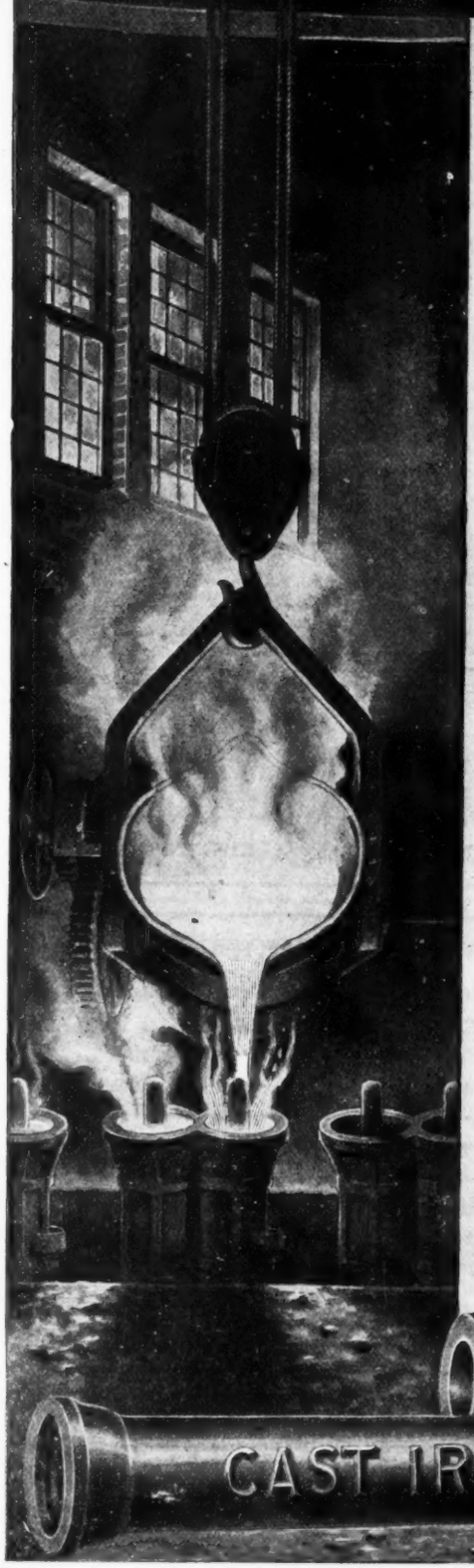
This made 23 charges in all which were distributed around the different points. By means of the blasting cap wires and some copper connecting wire, all 23 charges were connected up in series and attached to a 250-ft. leading wire running to the blasting machine which was so located as to afford the blaster proper protection when the blast was set off.

In all 85 lbs. of dynamite and 23 electric blasting caps were used. The blast caused the bridge to vanish like a soap bubble. The entire cost of the work, including labor, was $29.50.

WANTED—SITUATION

Mechanical Engineer—College graduate desires position as superintendent water plant, or mechanical engineer; state institution. Address care Municipal Engineering.

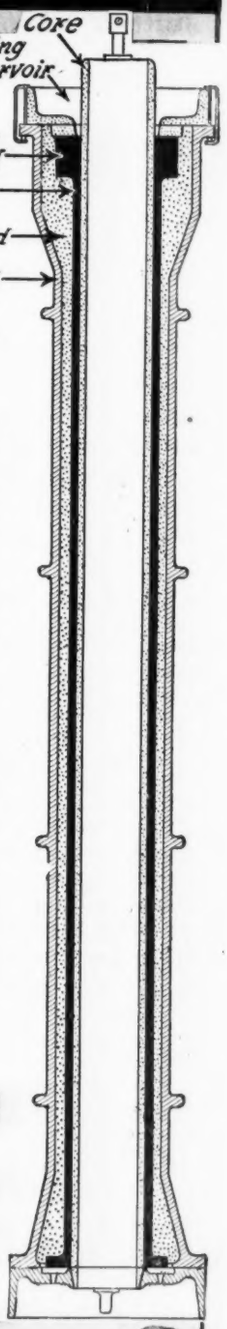
Why We Cast Pipe Vertically



THE early method of casting pipe was in a horizontal position, or "on the side," but as the standard of length increased from about 3 ft. to 6 ft., then to 9 ft., and later to 12 ft., the position of casting the moulds changed from horizontal to a slope and finally to the present vertical method.

These changes were made in order to obtain a better distribution of metal and more uniform wall thickness without the use of core chaplets, or anchors, and to insure stronger and cleaner castings by bringing all dirt, or scoria (which rises and floats on the heavier metal), to the top of the mould into a large runner or "head," which is cut off in finishing the pipe.

The core, having a tapered bottom end, is set in the mould resting on a "casting stool" with a corresponding taper which centers it at the bottom. The head core, or runner core, with holes or "gates" for the metal, is then placed in the top of the mould, thus centering the main or body core at the top. A deep runner or reservoir is made on top of the mould, which is then ready for casting.



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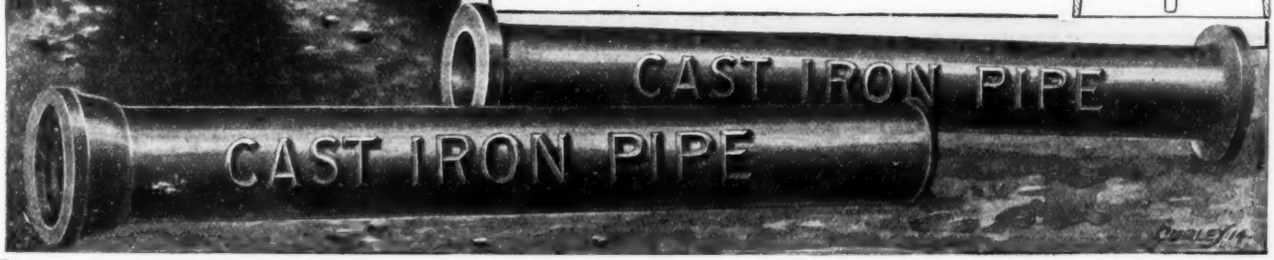

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Selling Municipal Bonds

When a county, city or town desires to sell an issue of bonds it usually prepares for publication a notice describing the issue and inviting sealed offers of purchase. The purpose of this is to let a number of buyers *compete* for the bonds, thus assuring a good price.

This method of selling bonds is an excellent one—*provided the notice of sale is given proper publicity.*

Municipal bonds are usually purchased by investment bankers. There are several hundred investment dealers making a specialty of municipal bonds. *Their offices are in the larger cities.* Local advertising of a bond offering has little or no chance of reaching these big cities or the bankers in them.

The connecting link between the borrowing municipality and the hundreds of municipal bond buyers scattered throughout the country is **THE BOND BUYER,** a daily and weekly newspaper devoted exclusively to municipal bond news and relied upon by all municipal bond dealers for advance reports of contemplated municipal financing.

Thousands of counties, cities and towns advertise all bond offerings in **THE BOND BUYER.** Under the laws of New Jersey, all bond issues must be advertised in a financial newspaper, and it is a fact that nine municipal bond issues out of ten issued by New Jersey communities *are advertised in* **THE BOND BUYER.**

The rate for inserting official notices of bond sales in **THE BOND BUYER** is low. When you are contemplating the offering of bonds, write for a copy of **THE BOND BUYER** and let us explain how we can *increase the premium* on your bonds.

The Bond Buyer

The Authority on Municipal Bonds

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Also have TURBINE SEWER CLEANING MACHINE at Low Price.

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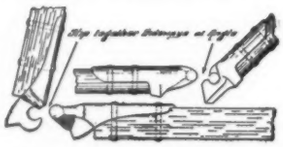

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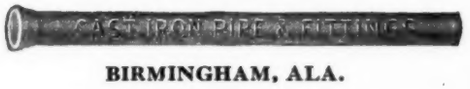

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CONSTRUCTION NEWS AND EQUIPMENT

CONCRETE ROAD MACHINERY AND LABOR SUBSTITUTES; SOME OF THE 1919 DEVELOPMENTS

By H. W. Eldridge, Engineer, Technical Department, The Atlas Portland Cement Co., 30 Broad St., New York.

Labor saving devices have always been studied for use on concrete road work. The use of these devices has been limited formerly to operations where economy only was considered. In the past when labor was plentiful, machinery was made use of if it could be proven to do more work at less cost than hand methods. It was simply a case of planning to use machinery if a saving in dollars and cents was shown over the use of hand labor.

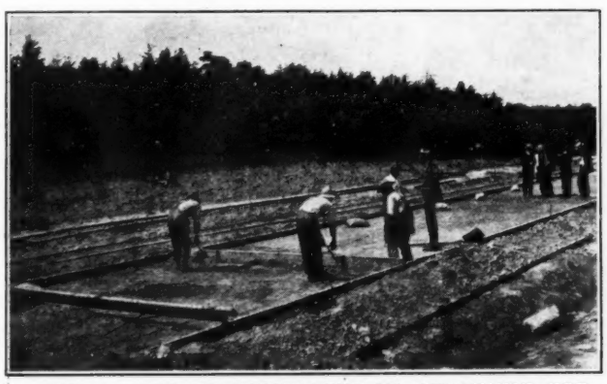


FIG. 1. USE OF TEMPLATES IN OBTAINING CORRECT SUBGRADE AND IN REDUCING WORK OF FINE GRADING.

The world war in which we have taken part has changed these conditions. There is now a scarcity of labor which is recognized by all executives needing the services of common labor. This dearth of labor has naturally been strongly felt by the concrete road builders. The contractor can no longer consider the use of machinery from the economical angle alone; he must have a broader outlook and plan to make use of every new idea in machinery which is developed, because it is impossible to obtain sufficient labor to execute the work now under way. He, therefore, is forced to be inventive, and if he fails to take advantage of all of the improved methods of concrete road construction he is absolutely doomed to failure.

Nineteen-nineteen has been the biggest year in history for concrete road construction, and this boom coupled up with extreme labor shortage has resulted in some wonderfully ingenious and effective inventions and methods.

Templates

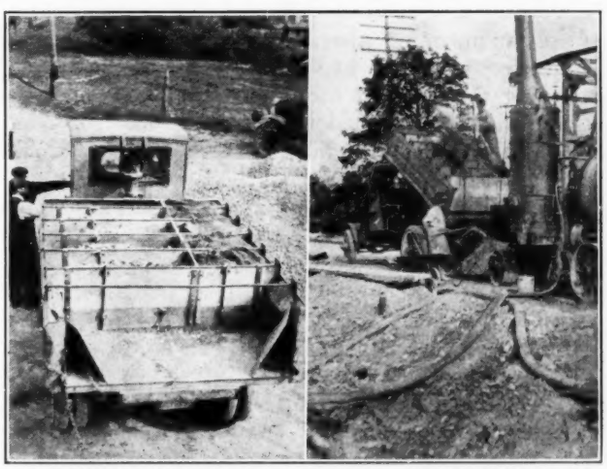
The subgrade is now given more attention than formerly and methods for fine grading are used which make one fine grading all that is necessary. In this work there are two templates used. These templates are shown in Fig. 1. Planks are notched at the ends so that when they rest on the side rails the desired grade is obtained. Iron handles are provided and two men can operate a template. The subgrade is loosened and then the templates are used. By this method a correct subgrade is obtained and the work of fine grading is greatly reduced and made more satisfactory.

Subdivided Motor Truck Bodies

Many methods for transporting aggregates from the stock pile or railroad cars to the mixer have been developed. The subdivided motor truck body has been used to advantage. The body is generally divided into five compartments, each compartment containing aggregates for one batch. Fig. 2 shows the truck ready to leave the storage yard with five complete batches of aggregates. Fig. 3 shows the truck dumping batches into a mixer skip. This method of hauling has proven economical. From 5 per cent. to 10 per cent. of the aggregates are saved which were formerly trodden into the subgrade, a more accurate and uniform method of measuring the batch is procured, and the labor on the skip end of the mixer is greatly reduced, all wheelers and shovelers being eliminated.

Combination of Industrial Batch Cars

Another method used for transporting aggregates from the storage yard to the mixer is the combination of industrial batch cars. A narrow gauge industrial track is laid from the unloading or storage yard along the shoulder of the road. The cars are each provided with two steel boxes, each box containing a complete batch of aggregates, see Fig. 4. The cars are run out alongside the mixer and the boxes are dumped into the skip by



SUBDIVIDED MOTOR TRUCK BODY FOR TRANSPORTING AGGREGATES.

FIG. 2. TRUCK READY TO LEAVE STORAGE YARD WITH FIVE COMPLETE BATCHES OF AGGREGATE.

FIG. 3. THE TRUCK DUMPING BATCHES INTO A MIXER SKIP.

Printed as insert to MUNICIPAL AND COUNTY ENGINEERING, January, 1920.

NEW AND OLD METHODS OF HANDLING AGGREGATES.

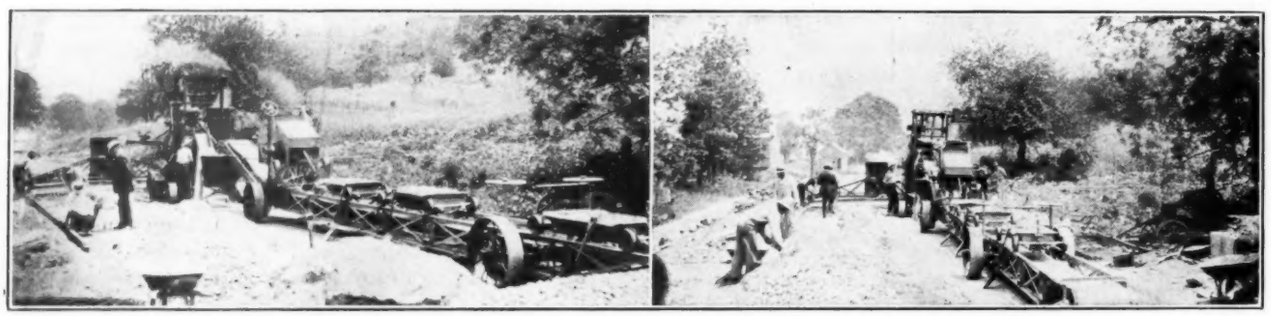
FIG. 4. USE OF INDUSTRIAL BATCH CARS IN TRANSPORTING AGGREGATES FROM STORAGE YARD TO MIXER. Narrow gauge industrial track from storage yard along shoulder of road. Each car provided with two steel boxes, each box containing a complete batch of aggregates. Cars are run alongside mixer and boxes are dumped into skip by means of small derrick boom on skip end of mixer. Notice orderly appearance of subgrade and few laborers required.

FIG. 5. OLD METHOD OF AGGREGATES ON SUBGRADE, WHEELERS AND SHOVELERS. NOTE THE CONFUSION AND THE GREAT NUMBER OF LABORERS REQUIRED.

means of a small derrick boom mounted on the skip end of the mixer. This hoisting equipment is operated from a nigger head on the mixer engine. Notice the orderly appearance of the subgrade and the few laborers required. The contrast is strongly brought to mind by examining Fig. 5. This is the old method of "aggregates on subgrade, wheelers and shovelers." Note the confusion and the great number of laborers required. The Lakewood Engineering Company has been one of the pioneers in developing this type of machinery and their equipment has been used with wonderful economy and the results have given satisfaction to the engineer and the contractor. There are many more methods used for cutting down hauling expenses and handling aggregates from railroad cars to mixer. In this short article it is not practicable to go into detail regarding all of these methods, although the writer fully appreciates the utmost importance of many of the other methods.

Mixer Loaders

Where it is deemed advisable to place the aggregates on the subgrade the contractor is confronted with the problem of selecting labor saving machinery for transporting the aggregates from the grade to the mixer skip. The Koehring Machine Company has put on the market one of the best appliances for this work. This machine is shown in Fig. 6, and consists of a belt conveyor mounted on a self-propelled truck 60 ft. in length. Small steel measuring hoppers are mounted over the belt conveyor. The aggregates are dumped from the hoppers onto the



FIGS. 6 AND 7. TWO VIEWS OF THE KOEHRING MIXER LOADER IN OPERATION.

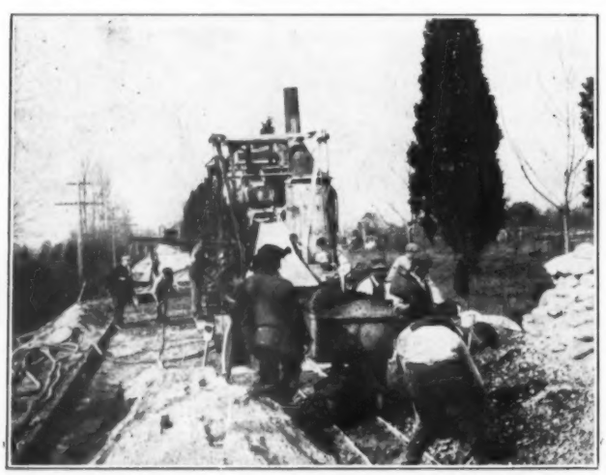


FIG. 8. USING SMALL INDUSTRIAL CAR TO HANDLE AGGREGATE.

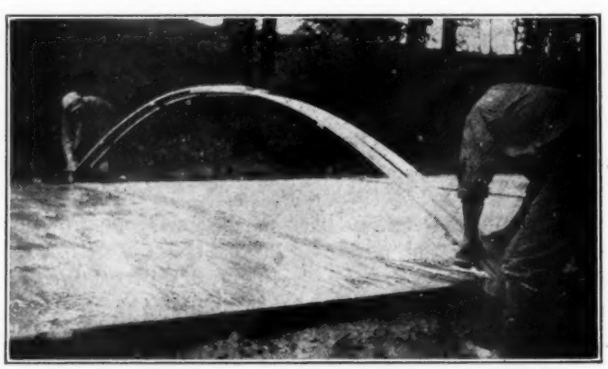


FIG. 9. LATEST METHOD OF BELT FINISHING A CONCRETE ROAD.

Shows bow and belt used on the Red Bank Middletown section, New Jersey State Route No. 4, by Heyman & Goodman, Contractors, Jersey City.

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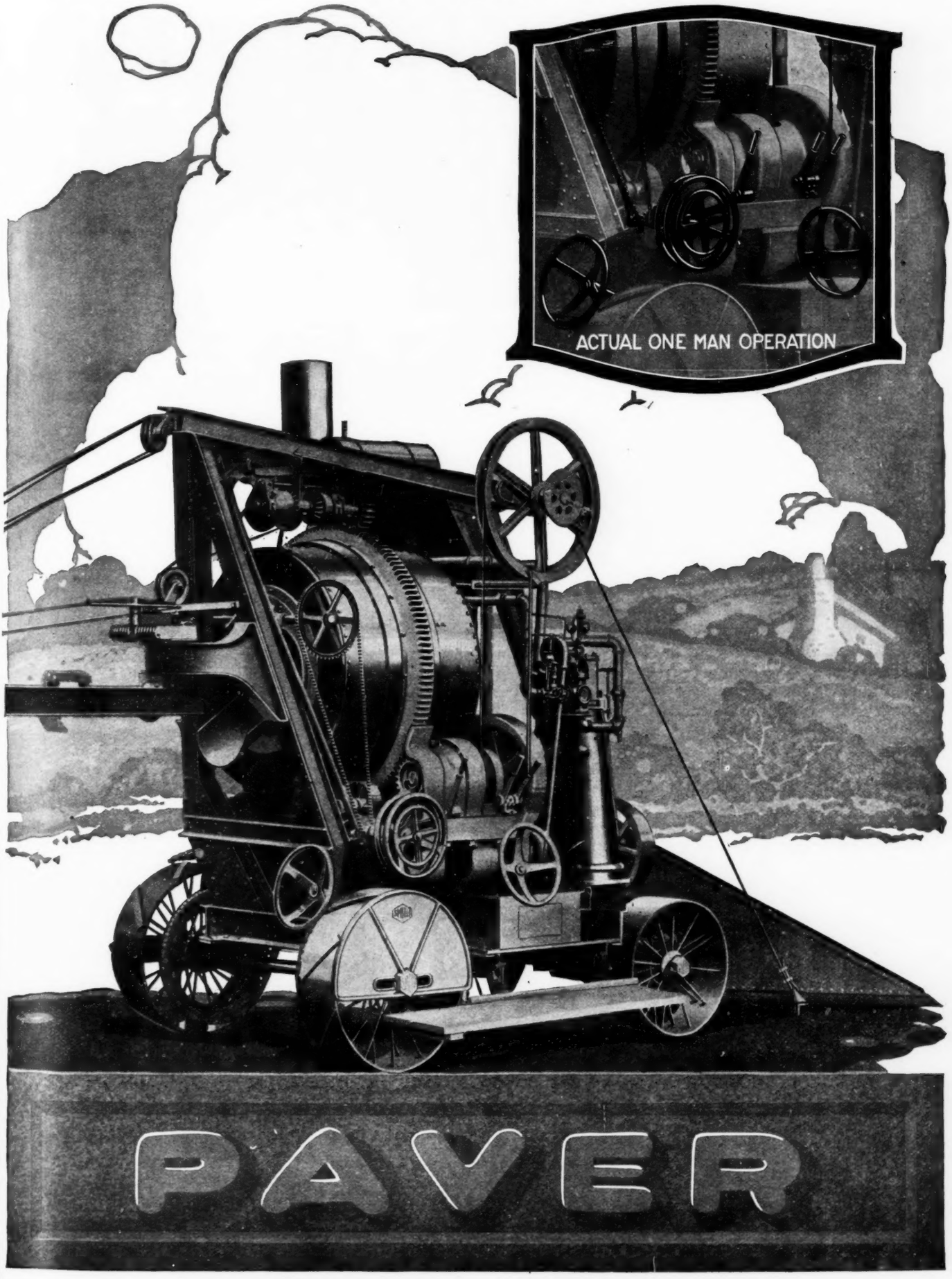
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FIG. 10. HEAVY STRIKEBOARD FOLLOWED BY A PLANK FOR FINAL FINISH.
FIG. 11. EFFICIENT STRIKEBOARD MADE OF CHANNEL STEEL PROVIDED WITH HANDLES.

conveyor belt and delivered to the skip. The use of this machine is advantageous as the labor is materially reduced (no wheelers needed), and accurate measurement of materials is obtained. Fig. 7 is another picture of the skip loader.

Using Small Industrial Car to Handle Aggregates

The small industrial car has been used with certain advantages for this purpose. Fig. 8 shows this method. A short piece of narrow gauge is laid on the subgrade from the piles of aggregates to the mixer skip. A small steel tipple car is loaded with a batch of sand and stone pushed by hand to the skip and dumped. It can readily be seen that shovelers only are needed and the result is that the cost of operation is very appreciably reduced.

Belt Finishing

Finishing methods have been improved. The belt and roller are still in wide use. Fig 9 shows the latest method for belting. This belt is held taut by a wooden bow. When a belt is used for finishing without a bow it has a tendency, as the belt advances along the surface of the wet concrete, to drag at the center. This of course, is caused by the adhesion of the belt to the lubricant of mortar. This dragging action causes the surface of the concrete to be ridged in diamond shapes, or as commonly called, "herring-boned." Therefore, it was considered important to provide rigidity to the belt. The bow adds sufficient tension to keep the belt in a straight line at all times and prevents curling. In this way the herring-boned surface has been eliminated and the surface obtained with the bowed belt is free from irregularities.

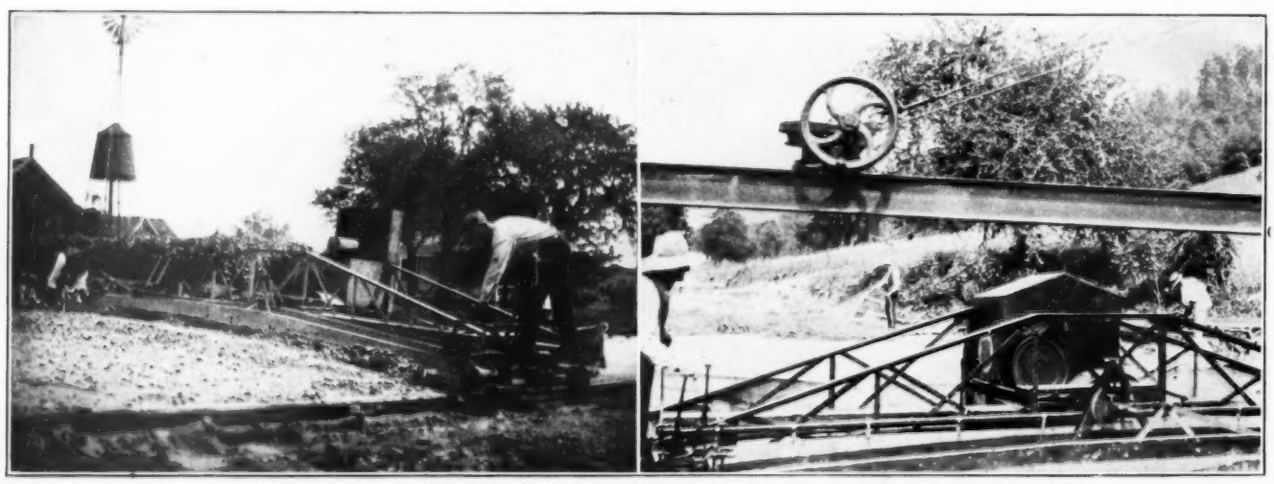
Strikeboard and Plank Finishers

On a great many road jobs the belt and roller method of finish has been displaced by the use of a heavy strikeboard followed by a plank for final finish, see Fig. 10. The strikeboard is pulled by two men in a longitudinal direction and two other men are used to produce the necessary transverse motion. This operation is followed by a plank with handles which results in a finish similar to the old wood float. A very efficient strikeboard has been made by using a piece of channel steel provided with handles as shown in Fig. 11. The striking is followed by the roller.

Mechanical Finishers

Many mechanical finishers have been put into use during the past few years. The Lakewood Engineering Company has produced an excellent machine, see Figs. 12 and 13. It is driven by a gasoline motor and rides the siderails. In Fig. 12 the rough concrete is shown at the left and the finished surface at the right. This machine strikes, puddles and finishes. The resulting surface is dense and offers high resistance to wear. Fig. 13 shows a "close up" and clearly illustrates the ease of operation.

The labor "saving" proposition on concrete road work at the present time should be considered from the



FIGS. 12 AND 13. VIEWS OF THE LAKEWOOD MECHANICAL FINISHER WHICH STRIKES, PUDDLES AND FINISHES.

labor "substitution" angle. The writer has endeavored to feature a few of the latest developments in the mechanical substitution of labor. Road construction machinery deserves wide publicity under present day conditions.

THE AUSTIN WAGON LOADER

The Austin Wagon Loader with patented self-feeding device is a distinct advance in the multiple-bucket-type of loader. Its greatest economy of operation is due entirely to the self-feeding device, which is not merely a so-called man saver, but actually does away with the necessity of keeping two men to feed the buckets, as required on other machines.

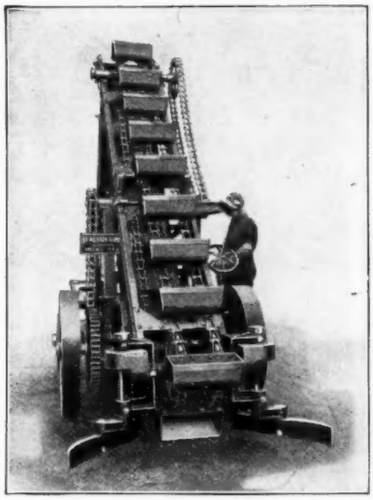
This device consists of two shovel-shaped feeders, which sweep continuously through the pile to be removed, with a range of cut 6 ft. wide, carrying the material into the bucket path and automatically withdrawing in preparation for the next cut.

The elevator proper is arranged for vertical movement, both for cutter adjustments and folding back for shipping clearances in traveling. The power plant consists of a 22-H. P. engine of marine type.

The operating machinery consists of a direct drive chain and gear transmission, giving elevator operation, and two-speed and reverse traction. The low or feeding speed is provided for use under working conditions, while the high is for traveling.

The platform is provided for the operator and all levers are easily within his reach, even the steering lever for the front wheels.

In the accompanying illustration the loader is shown



AUSTIN WAGON LOADER READY FOR OPERATION

ready for operation with the steel feeding arms extended to their outside radius of 6 ft. These feeding arms dig into the material to be loaded, gather it up and pull it into the elevator buckets. These arms will cut a swath wide enough for the machine to follow into or through the bank, and every bucket can be filled to the brim. There

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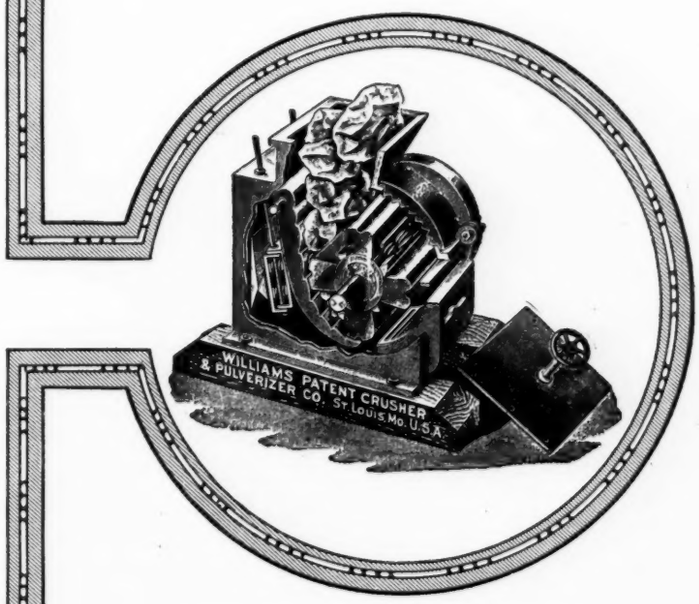

THE WILLIAMS PATENT CRUSHER & PULVERIZER CO.

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are 22 buckets, each holding 1/3 of a cubic foot. The buckets complete 3 1/3 cycles per minute, giving the machine a capacity of 38 cu. ft. or 1.42 cu. yds. per minute. The work is all done by one or two men depending upon the nature of the material and the conditions under which it is placed.

The loader has a traction road speed of 7/8 of a mile per hour and a backing speed, which forces the digging arms into the bank, of 28 ft. per minute. Neither the bucket nor the digging arms have to be stopped, whether backing the machine or going ahead. Ample horse power is provided for this is one of the prime factors of getting good results. The loader is fitted with a spout for delivering into wagons or is furnished with a bin gate for wheelbarrow work. The manufacturers also make a discharging spout with dust screen for catching the dust when loading hard coal.

The Austin Wagon Loader is especially adapted for loading crushed rock, gravel, sand, coal, etc. It is an ideal outfit for loading material from bottom dump cars. This loader is manufactured by the F. C. Austin Company, Inc., Railway Exchange Building, Chicago. Further particulars are given in catalog No. W-L6.

FEATURES OF THE SMITH SIMPLEX PAVING MIXER

The Smith Simplex Paving Mixer presents, among other features, one very important improvement that the contractor has long been waiting for. This is the feature of convertibility which makes it possible to change the mixer from a boom-and-bucket type to a chute delivery type or vice versa.

In some districts the paving contracts call for a paving mixer equipped with the particular type of discharge favored in the eyes of the engineers in charge. This situation has not infrequently made it necessary for the successful contractor either to sell his paver or allow it to stand idle and purchase a new machine equipped to meet the specifications. In the Smith Simplex the contractor finds relief from this condition. The frame of this paver is so constructed that it can be equipped with either boom-and-bucket or chute and the arrangement is so simple that the change can be made anywhere—right on the job if necessary. This gives the Smith Simplex a range of usefulness never possible in the old style rigid one-type paver.

The Smith Simplex is the highest high drum paver on the market. The advantages of this feature are manifold. If it is equipped with chute discharge it gives the chute a pitch of from 20 to 30 degrees which makes possible a steady flow of concrete by gravity alone. Stiff or thin mixtures can be poured down the chute with equal facility and without losing any of their strength. If the paver is boom-and-bucket equipped the high drum makes possible a high boom and a long deep bucket. The boom on the Smith Simplex is 7 ft. high, allowing ample space for workmen to pass below it.

To further increase its usefulness the Smith Simplex can be equipped with either wheel or caterpillar traction. This, like the delivery, is interchangeable. The caterpillar is of the oscillating type, 18 ins. wide and extending over the rear half of the paver. The caterpillar is protected with steel treads throughout and is of an advanced, trouble-proof design.

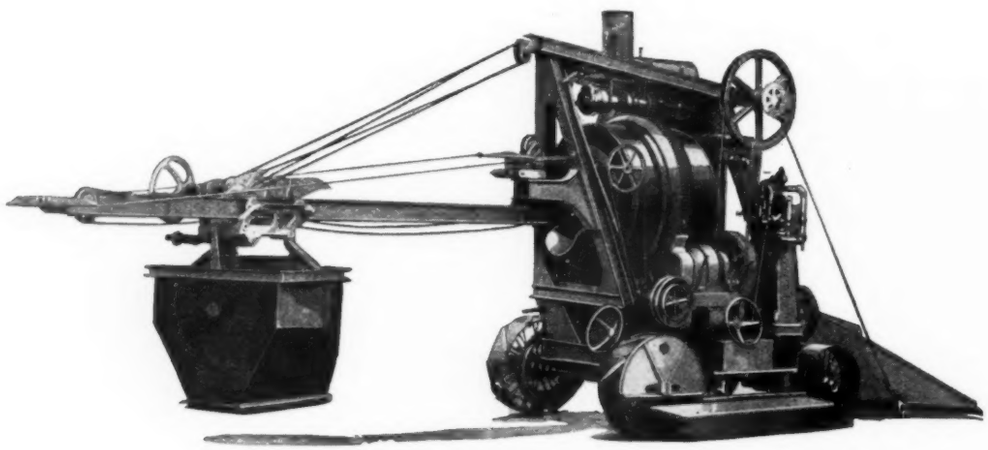
Some of the other interesting features in connection with the Smith Simplex Paving Mixer are: Actual one-man-operation, strongly reinforced frame, fewer working parts, speedy skip, quick discharge, efficient power plant, and automobile steering gear. An interesting book entitled "101 Reasons" for the Smith Simplex Paving Mixer will be sent to interested parties. Write the T. L. Smith Company, 3267 Hadley St., Milwaukee, Wis.

USE OF EQUIPMENT CUTS COST ON CONSTRUCTION OF A NEBRASKA CONCRETE ROAD

The use of equipment reduced to a minimum the cost of constructing a 6-mile concrete road from Fremont to Ames, Neb., during the 1919 season. The total contract cost of the work was $199,440.

In the construction of the road, the contractors, The Hugh Murphy Construction Company, of Omaha, provided machinery and equipment with a view of reducing hard labor and horse work to the lowest possible minimum.

Work started near Fremont, and at that place the concrete mixer moved from place to place by its own



THE SMITH SIMPLEX PAVING MIXER

power. It was a batch mixer type, mounted on caterpillar feet, provided with steam boiler engine, and water measuring device, as well as with the usual chutes and appliances for loading and dumping the mixing drum.

The water for mixing the concrete was furnished by means of a line of wrought iron pipe, leading from a group of driven wells which were operated by a 6 by 10-in. pump. The pump was mounted upon skids resting on the ground, and was belt-driven from a gasoline engine which rests on a special horse-drawn truck.

Trucks Used to Haul Materials

Concrete materials were brought to the mixer in 1-ton trucks, provided with dump bodies. Each truck brought in one load, all the materials necessary to mix one batch of concrete. These were dumped into the loading chute of the mixer. The trucks were loaded at the stock piles, located at intervals near the road, where sand and gravel had been dumped to drain after having been dredged from a subaqueous deposit. This pit was approximately 30 ft. deep, and was located near the middle of the contract.

A Gravel Loader Eliminates the Work of Ten Laborers

The trucks were loaded by a loader. It was operated by a gasoline engine which could be moved from place to place by its own power. By a shifting of levers and gears, the engine started a chain-belt elevator, which carried excavating buckets. These scooped the sand and gravel, carrying and emptying them into a hopper which served as a measuring box, delivering to each truck the proper amount of the materials for one batch of concrete. The work of eight to ten laborers was eliminated and work accomplished in half the time by the machine. An ingenious device supported the digging end of the machine upon the solid earth beneath the stock pile, preventing the buckets from digging earth and equalizing the supply of material upon which the excavating buckets worked.

Road Rails Perform Duty for Truck and for Side Forms of Concrete Pavement

The concrete was finished with a Lakewood Road finisher carried upon Blaw-Knox road rails. These rails were designed to perform both the duty of forming the side forms, for the concrete pavement, and provided a track at each side of the pavement upon which the finishing machine operated. The finishing machine shaped the

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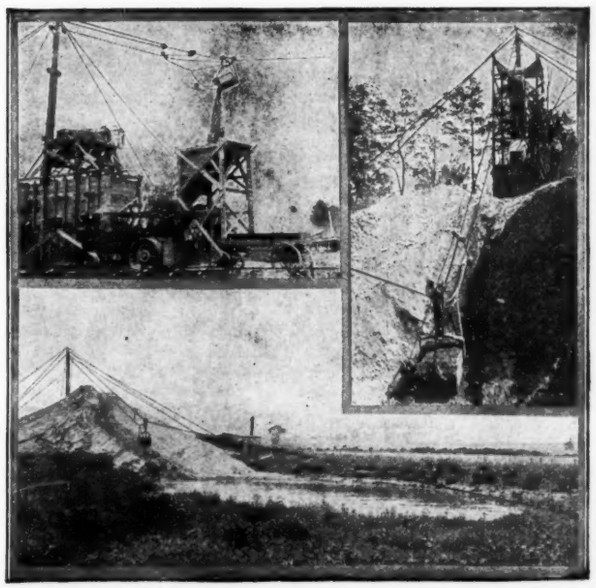

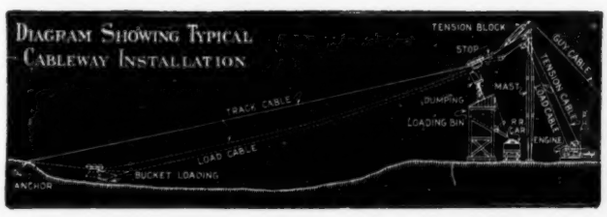

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form of the finished road, tamped the concrete, rolled the surface and forced out the surplus water. It rubbed the surface of the concrete down with a strip of belting, in order to give the proper gritty finish. Between the drum of the mixer and the discharge end of the concrete chute a steel shod strike-board, rests upon side forms. This accurately gages the surface of the finished subgrade. Imperfections found in the subgrade at the time of finishing are corrected by hand labor.

At intervals, not exceeding 36 ft., the pavement is divided into blocks, separated by sheets of elastic paving joints, which extend the full depth of the surface.

Highway Trucks Haul Materials

State highway trucks, received from the War Department, were used to haul cement from the railroad to the road, where it was stored on platforms, a few hours' supply at a time. The 1-ton trucks passed on their way from the gravel to the mixer and loaded the cement sacks. Highway trucks were used to haul coal and lumber and also for the longer haul, from digging plant to the stock piles.

Roller Scraper Used in Finishing

A 10-ton steam-driven road roller was used to compact the subgrade, and for all rolling in connection with the rough grading. Fine grading was done by hand, proceeded by a blade grader drawn by horses and followed by the 10-ton roller.

Rough finishing was done mainly with Fresno scrapers, an enlarged and improved old drag scraper, with an 8-ft. cutting edge. Four horses were required to operate it. Two-horse plows and the common two-horse drag scraper were used to a limited extent in contracted spaces and narrow ditches. Blade graders were used wherever profitable, in smoothing off and leaving the smaller ridges where only small center cuts occur.

CONTRACTS AWARDED

ROADS AND STREETS

Ark., Ft. Smith—Louis Rich Constr. Co., E. St. Louis, Ill., awarded contract to construct 74 miles of highway out of Ft. Smith, through Greenwood District, at $1,400,940.

Ark., Little Rock—State Hwy. Dept. has let contracts for highway between North Little Rock and Jacksonville as follows: Camp Const. Co., Atlanta, Ga., concrete stretch between N. Little Rock and Booker; M. D. L. Cook, Little Rock, Warrenite stretch from Booker to Jacksonville; Moreno-Burkham Constr. Co., St. Louis, Mo., asphalt wrk. on N. Little Rock St., at abt. $700,000.

Ark., Little Rock—Oliver Constr. Co., Benton, Ark., awarded contracts by Little Rock & Spring Lake Hwy. Dist. for constr. of 27.5 miles roads in Pulaski and Calines counties, conc. and tile culverts, at $175,000.

Cal., Bakersfield—Rogers Bros. Co., 350 Merrick St., Los Angeles, awarded contract for constructing conc. pavement 6 ins. thick and 15 ft. wide—Fellows to McKittrick—10.683 miles, at $369,000.

Cal., Sacramento—Following contracts awarded by State Hwy. Dept.: M. D. Goodbody, San Diego, awarded contract for grading 6.6 miles San Diego county, at $55,827; Wright & Doran, San Diego, awarded contract for grading 13.8 miles, San Diego county; Casbere ranch to Tecate Divide, at $168,267; Palmer & McBryde, San Francisco, contract for grading 4 miles, Del Norte county, between Cushion Creek and Crescent City, at $32,537.

Conn., Hartford—Contracts for roads awarded as follows: Town of Canaan, 5,550 ft. gravel, Arborio county, New Haven, at $18,889; Town of Salisbury, 5,550 ft. gravel surface on slag base, to F. B. Hastings, Bridgeport, at $17,000; Town of Thomaston, 4,750 ft. trap rock, to J. H. Grosier Co., Hartford, at $32,000; Town of Watertown, 16,060 ft. concrete, to J. H. Grosier, at $120,000.

Ga., Madison—Case & Cathran, Chandler Bldg., Atlanta, awarded contract for 29,000 sq. yds. paving, 6,000 cu. yds. excav., 18,100 lin. ft. granite curb and 73,000 sq. ft. conc. walk, at $141,680.

Ga., Quitman—F. W. Long Co., Jacksonville, Fla., awarded contract to pave 5 miles Quitman-Morven Road, 9-ft. conc., $100,000.

Ga., Savannah—Lawrence Constr. Co., Augusta, awarded contract for Louisville Road (conc. construction, also includes bridges), at $373,000.

Ga., Savannah—W. T. Hadlow, Jacksonville, Fla., awarded contract by Chatham Co., Commrs., to grade, drain, pave 116,688 sq. yds. on Ogeechee Road, bridges and culverts, at $381,845.

Ga., Sylvester—Speed Parker, Inc., Louisville, Ky., awarded contract by Worth County Commrs. to construct 3.95 miles Sylvester and Albany Road, 37,333 sq. yds. Kentucky rock-asphalt over slag macadam, 6-in. base, at $100,000.

Ill., Springfield—Following contracts awarded: C. W. Clark Co., Clinton, Ind., contract for conc. and brk. rd. in Vermillion Co., at $83,994, 2 earth roads in LaSalle Co., to Powers-Thompson Constr. Co., 221 S. Chicago St., Joliet, Ill., at $134,362; 3 concrete rds., to Powers-Thompson Constr. Co., at $647,572; 2 conc. rds. Madison and Bond Cos., to Highland Lbr. & Constr. Co., Highland, Ill., at $112,410 and $110,632, respectively; 2 conc. rds. in Bond County, at $273,500 and $110,167.

Ind., Indianapolis—Central States Construction Co., Logansport, awarded contr. for constr. of concrete hwy.—Osgood to Versailles—5.574 mi. in length, at $223,151.

Iowa, Leon—Akins & Flutters, Corning, awarded contract for paving, at $201,000.

Ia., Odebolt—Western Asphalt Paving Co., 1st and Nebraska Sts., Sioux City, Ia., awarded contract for paving, at $650,000.

Kans., Ft. Scott—Dolan & Son, Junction City, awarded contract for macadamizing 4½ miles Pawnee Rd., 16 ft. wide, at $139,678.

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Kans., Norton—E. W. Geiger Constr. Co., 626 Cherokee St., Leavenworth, awarded contract for paving 10 blocks E. Main and State Sts., Norton and First Aves., at about $210,000.

Maine, Augusta—M. Seretto and W. D. Smith, No. 3 Tremont Row, Boston, Mass., awarded contract for State Hwy. Comn., Augusta, for grading, draining and gravel surfacing 7.05 miles river road, 16 ft. wide, with 2½ ft. shoulders, Enfield Twp., involving 13,300 cu. yds. earth and 50 cu. yds. rock, excav., 2,450 cu. yds. borrow, 20,820 cu. yds. gravel, etc., at $99,349.

Mass., Boston—Jas. Doherty, awarded contracts for recut granite blk. and wood blk. paving on Federal Street; also wood blk. paving on Lincoln Street, at $20,973 and $43,055, respectively; Rowe Contracting Co., Boston, awarded contr. for surfacing rd. in Lunenburg, at $113,375; rd. in Bernardston and Greenfield, to West Roxbury Trap Rock Co., Boston, at $117,010; Antony Cefalo, award. contr. for grading Centre St., at $9,875; sheet asph. paving on Tremont St., to B. E. Grant Co., at $99,033, Topeka paving on Hyde Park Ave., to Martino Dematteo, at $124,585.

Mich., Lansing—Hall & Labby, Ironwood, awarded contract for road No. 35-9D, Marquette, 7.47 miles long, at $117,500; Garvey & Weyenberg Constr. Co., Appleton, Wis., contr. for Rd. No. 35-5-E, Marquette Co., 9.007 mi., at $160,000.

Minn., Alexandria—General Contracting Co., 1254 Plymouth Bldg., Minneapolis, awarded contract for paving on G. Street and 6th Ave., bith., 6-in. at total of $145,-756.

Miss., Indianola—Healey Constr. Co., Meridian, awarded contract by Sunflower Supvrs., for constructing 53 miles of roads in Dist. No. 5; concrete and gravel; at $400,000.

Mo., New Madrid—Albert Greek, Gideon, Miss., awarded contract for constructing state road project No. 15. 19.5 miles, at $172.582.

Mo., St. Louis—F. A. Stiers, 4512 Enright St., awarded contract for widening from 24 to 100 ft., and resurfacing one mile Washington Ave.,—Jefferson to Teresa Aves., involving vitr. brick paving and 5280 lin. ft. curbing and guttering, at $236,583.

N. J., Newark—Northern Constr. Co., 423 Amherst St., East Orange, awarded contracts for paving Grove St. and Lyons Ave., at $26,665 and $81,792.

N. Y., Albany—Belmar Contracting Co., Inc., N. Y., awarded contract for impvt. of Rd. No. 1572, Oakwood Ave., Rensselaer Co., 1.27 mi., at $41,906; John B. Dower, Ballston Spa, N. Y., contract for Malta-Bemis Heights, Rd. No. 1528, Saratoga Co., 4.17 miles, at $167,257; Wm. G. Fox, Saratoga N. Y., contract for Rd. 1117, Rexford Flats-Wait Cors. Groom Cors., Saratoga Co., 6.10 miles; Rosoff Engineering Co., New York City, Rd. 1450-A, Castle Creek-Whitney Point, Broome Co., 3.93 mi., at $304,874; Jno. D. Rust, Buffalo, N. Y., Rd. 1428, Sandy-Creek-Smartville, Oswego Co., 6.36 mi., at $95,405; Fred W. Knickemberg, Buffalo, N. Y., Rd. 1267, Bennington-Attica Rd., 6.99 miles, at $130,388; Sweeney and Boland, Rochester, N. Y., Rd. 5650, Canisteo-Whitesville, Pt. 3, Steuben Co., 2.00 miles, at $56,369.

N. Y., New York——Sicilian Asphalt Paving Co., 41 Park Row, awarded contract for improving carriage drive in Central Park, asph. concrete, at about $106,000.

N. Y., Rochester—J. Friedrichs Co., Livingston Bldg., awarded contract by Bd. Constr. & Supply, for paving, bldg. walks and sewers in Norton Street, Portland, Ave. to Waring Rd., at $108,729.

N. C., Kinston—B. H. Gill Co., Binghampton, Tenn., awarded contract for grading and draining; C. W. West Constr. Co., Chattanooga, Tenn., contract for laying the sheet asph. paving on 21 miles Central Hwy., at $135,000 and $570,000 respectively.

Ohio, Garfield Heights—Cleveland Trinidad Paving Co., The Arcade, awarded contract to pave Garfield Heights Blvd., involving 520,000 sq. ft. asph. on 6-in. concrete base, at $108, 977.

Okla., Durant—Edward G. Baum, Durant, awarded contract by Council for street paving, at $214,942. Concrete paving will be laid on portions of 6th Ave., 8th Ave., 9th Ave. and Elm Street; alleys in business distr., Lost Street and Second Ave. will be paved with brick.

Pa., Harrisburg—Benj. Foster Co., Philadelphia, awarded contr. for 20,902 ft. concrete roadway, 18 ft. wide, betw. Morrisville and Tullytown, Bucks County, at $144, 086; Phila. Paving Co., awarded contr. for 27,633 ft. state aid rd. bitum. mixt. constr., betw. Yellow House and Douglasville, Berks Co., at $60,424; T. M. Gill Co., Binghamton, N. Y. awarded contract for 19,215 ft. rein. conc. rdway in Wysox and Rome Twps., Bradford Co., at $150,568; E. M. Love & Son, Corry, contract for 7,900 ft. near Northeast Erie Co., at $72,524.

R. I., Providence—B. Perini, Ashland, Mass., awarded contract for construction of road in Coventry and Foster, at $107,806.

Tenn., Rogersville—Southern Constr. Co., Harriman, Tenn., awarded contr. to construct 43 miles Memphis-Bristol Hwy., at $1,000,000.

Texas, Abilene—Sanders Brothers, Miami, Texas, awarded contract for 16¾ miles of road construction; Womack Construction Co., Sherman, Tex., contract for 40 miles, at total cost for both contracts $300,000.

SEWERAGE AND SEWAGE TREATMENT

Cal., Los Angeles—John Balch, 696 12th Street, San Pedro, awarded contract for constructing clay pipe sewers in Gulf Ave., B to Anahei Streets; also streets in the Gulf Ave. Sewer District, Wilmington, at $232,560.

Ill., Clearing—American Sewer Pipe & Drain Co., 2816 N. Washtenaw Ave., Chicago, awarded contract by Alvord & Burdick, Engrs., S. Dearborn St., Chicago, for bldg. sewer system, involving 3 miles 12-39 in. sewer pipe, (mostly vitr.) for Chicago & Clearing Transfer R. R. at about $100,-000.

Iowa, Osage—O'Neill & Preston, 60 E. 6th St. Paul, award. contr. for sewer system, at $253,000. Work will start immediately.

Iowa, Pocahontas—Turner Impvt. Co., 309 Youngerman Bldg., Des Moines, awarded contract for bldg. 1¼ miles sewers in various streets, at $109,612; sewage disposal plant to B. D. Viegel, Webster City, at $21,900.

La., South Highlands—Fleniken Construction Co., Knoxville, Tenn., awarded contract to construct 10,683 lin. ft. storm sewers; 65,000 sq. yds. asph. conc. paving, conc. base, conc. curb, etc., at $278,968.

Mass., Chicopee—City will construct 7,-950 ft. segmental block and vitr. pipe sewers in Driving Park. About $173,000. Work will be done by day labor.

N. Y., Long Island City—Booth & Flynn, Montague Street, Brooklyn, award. contract for bldg. sewer in Linden St., Sec. A, at $925,100; Sect. B. to O'Rourke Con-

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tracting Co., 150 Nassau St., New York City, at $876,062.

N. Y., Long Island City—Following sewer contracts awarded by Pres. Queens Boro: Booth & Flynn, Ltd., 17 Battery Pl., New York City, $89,500; P. J. Donlan Contracting Co., 82 S. 3rd. St., Brooklyn, $460,664; C. Petracca, 175 Spencer St., Brooklyn, $2,692; Ashland St., to J. H. Johnson Contg. Co., $5,271.

N. Y., New York—C. McDonald, 1910 Webster Ave. awarded contract by Pres. of Bronx Boro. for bldg. sewer and appurts. in Holland Ave., at $213,721.

W. Va., Martinsburg—Cox Contg. & Lumber Co., Martinsburg, awarded contr. for bldg. sewage disp. plant, at $48,562.

Wis., Chippewa Falls—P. L. McQuillan, 32 W. Central St., awarded contract for bldg. sewers in various streets, at about $80,000.

Wis., Kewaunee—Gray-Robinson, 8th St. Manitowoc, award. contr. for excavating and lay'g 3.1 miles 10-in. vitr. pipe sewers in various streets at $34,890.

Wis., Milwaukee—Greene & Sons Co., 332 S. Michigan Ave., Chicago, award. contract by Sewerage Commission, for bldg. 280. ft. rein. conc. syphon, 7-ft. diam., and 2 shafts in Muskego Ave. under Menomonee Canal, at $116,870.

WATER SUPPLY AND PURIFICATION

Cal., Inglewood—Mike Murphy, 1321 Milvia Street, Berkeley, Cal., award. contract for furnishing and laying mains for the new municipal water system, using lead joints, at $56,631.

Cal., San Diego—H. D. Hallett, 132 Downer Place, Aurora, Ill., awarded contract (omitting domestic water mains planned separately from fire mains) for constructing water and sewers systems for the Madine base on Dutch Flats, Dan Diego, under Spec. No. 4007, at $185,600. This does not include the fuel storage reservoir for which separate bids will be taken this month.

Conn., Groton—F. D. Miller, Poquetanuck, awarded contract by Bilderbeck & Langdon, Engrs., 253 State St., New London, for extending water system for town. Work involves abt. 13,000 ft. 6-12 in. c. i. pipe, etc. About $50,000.

Colo., Flagler—Gordon Constr. Co., Century Bldg., Denver, awarded contract by Council to construct water works system, at about $60,000.

Iowa, Grand Junction—C. W. Rolland Co., 215 Good Block, Des Moines, Ia., awarded contract for bldg. water works system, at $30,000.

Iowa, Mitchellville—Pittsburgh-Des Moines Steel Co., 9th & Tuttle Sts., Des Moines, awarded contract by City for water works impvts., including pumping station, power transmission line and wells, involving 10,200 ft. 6-in. cast iron pipe, at about $26,000.

Iowa, Toledo—Pittsburgh-Des Moines Steel Co., 9th & Tuttle Sts., Des Moines, awarded contract for bldg. 100,000-gal. elevated steel tank and tower and extensions to distributing system, involving 15,000 ft. 4-8 in. c. i. pipe, at about $42,000.

Iowa, Wapello—David G. Fisher Co., 206 E. 4th St., Waterloo, awarded contract to install motor-driven plant, 1 to 34-in. and 1 to 26-in. pump, 300 k. w. generator, at $126,000.

Ky., Ashland—J. E. Nelson & Sons, 117 N. La Salle St., Chicago, awarded contr. to build 2,000,000-gal. filtration plant, centrif. pumping plant of seven units and a 35,000-gal. wash water tank.

Mass., Auburn—Auburn Water Company will extend water system; work to be done by day labor, about $20,000.

Mass., Chicopee—City will lay 8 and 12-in. c. i. pipe in various streets; work to be done by day labor. Est. cost abt. $20,500.

Mich., Detroit—Water Comn., will lay 6,-ft. 6-in. cast iron water pipe with necessary valves, etc., in Craigwood, Erie, Muirland, Spaulding and Hazelwood Aves.; also 15,915 ft. 8-in. c. i. pipe in Six Mile Rd., Lennox, Hanna, Parkside, etc., by day labor.

Mich., Detroit—City will lay 14,185 ft. 6-in. mains by day labor in various thoroughfares; 8-in., 10-in., 12-in. and 24-in. mains.

Mich., Hamtramck (Detroit, P. O.)—J. A. McDace Co., Fairview Ave., Detroit, awarded contract for laying water mains in Yemens, Evaline,, Christopher and McDougal Aves., involving 2,755 ft. 6-in. and 150 ft. 8-in. o. i. pipe, at about $6,000.

Minn., St. Paul—Badger Meter Co., Milwaukee, Wis., award. contr. for furnishing and delivering f. o. b. freight cars, St. Paul, 1,500 ⅝-disc type water meters and couplings, at $12,600; Hooker Chem. Co., 40 Wall St., N. Y. City, award. contr. for furnishing f. o. b. cars St. Paul, approx. 20,000 lbs. liquid chlorine in 100-pound cylinders, at total cost of $1,600.

Minn., Grand Rapids—Wm. McVeigh, Village, awarded contract for water main extension—Brown Avenue to the veneer works west of village—about a mile, at $6,-967.

Minn., Grand Rapids—J. Ame Vey, Grand Rapids, awarded contract by city to build water mains in various streets, involving 3,622 cu. yds. earth excav., and backfilling, 10 cu. yds. rock excav., 6,112 lin. ft. 4-8 in. c. i. pipe, etc., at $6,967.

Minn., Hibbing—Following contracts let: Water services to G. L. Thouin Hdw. Co., 306 3rd Ave., Hibbing, at $8,151; gas main extens. to Schicmer Bros., 216 Center St., Hibbing, at $8,372; water main extens. to E. W. Coons Co., 2321 First Ave., Alice, Hibbing, at $34,561.

Minn., Redwood Falls—W. C. Fraser, Guardian Life Bldg., St. Paul, award. contract for extending water works, also sewerage systems, involving 2,180 ft. 6-in. water mains, etc., at $7,790.

Minn., St. Paul—Robinson, Cary & Sands Co., 4th & Wacouta Sts., awarded contract for pumping equipt., at $12,500.

Minn., Watkins—W. D. Lovell, 1415 8th Sy., SE., Minneapolis, Minn., awarded contract for water works system, at $12,780.

Neb., Albion—Howard McCray, Albion, awarded contract for 4 water main extensions on Third, 5th, 6th and Church Streets; about 36,000 ft., at $7,347.

Neb., Newman Grove—Arthur B. Dobson & Co., 80 First Nat'l Bk. Bldg., Lincoln, Neb., awarded contract for water extensions.

Neb., Ord—Hamond-Cruse Constr. Co., Spencer, Ia., awarded contract for water works impvts., at $10,300.

Neb., North Platte—Kelly Well Co., Grand Island, awarded contract for digging well at prop. auxiliary pumping plant at Locust and A Streets. Wells to give 750,000 gals. water daily.

Neb., Venango—Hennessy & Co., Omaha, awarded contract for constr. of water plant, at $26,000. Work will begin in Spring.

N. Y., Marcy—Scott Bros., Arlington Blk. Rome, awarded contract by State Hosp. comn., Capitol, Albany, for bldg. concrete dam, gate house, reservoir and appurts., for Marcy Div. of Utica State Hospital here, at $158,014.

N. Y., New York—Beaver Engineering & Contracting Co., 51 Chambers St., award. contract for laying water mains in E. 167th St., at $376,406; Masterson Constr. Co., 15 E. 40th St., contract for water mains in E. 161st and 164th Sts., at $13,262.

N. C., Franklinton—J. J. Quinn Co., et al, Franklinton, awarded contract to build water works and sewerage system, including deep well and Imhoff tank, at about $88,000.

N. D., Fairmount—Minneapolis Steel Machinery Co., 29th & Minnehaha Sts. Minneapolis, award. contract for bldg. water works and well system; also McCarthy Well Co., Wabasha and Eustis Sts., St. Paul, at total cost of $50,000.

Okla., Hennessey—Ray Reynolds, Geary, awarded contract for constr. of city well near Turkey Creek, at $1,700.

Okla., Perry—Alderson & Knox, Perry, awarded contract for constr. of dam for water and electric light systems.

Okla., Shattuck—Merkle Machinery Co., 508 Interstate Bldg. and American Cast Iron Pipe Co., 716 Scarritt Bldg. Kansas City, Mo., awarded comb. contract for improving water works and electric systems, including hydrants, valves, wells, power equipt. and c. i. pipe, at $75,957.

Pa., Saltsburg—L. H. Shram Construction Co., Pittsburgh, awarded contract for 5,000,000-gal. reservoir.

S. C., Williston—Geo. C. Osborne, Clinton, S. C., awarded contract to construct water works distribution system, at $31,000.

Texas, Port Arthur—Pittsburgh-Des-Moines Co., Dallas, awarded contract by City for constr. of elevated water tank of 300,000-gal. capy.

PROSPECTIVE WORK

ROADS AND STREETS

Ark., Little Rock—City considering organizing Impvt. Dist. to pave Markham Street—Prospect Ave. to Ridgeway, Ridgeway to Lee Ave. and Maple Street to Prospect Ave. Concrete may be used. Est. cost $40,000.

Cal., Elsinore—Paul E. Kressley, Newport Beach, Consit. Engr., has been retained by City Trustees to prepare plans and specfs., and to supervise paving of city streets at estimated cost of about $50,000. A 5-in. conc. pavement not less than 18 ft. wide will be laid on portions of Main and Spring streets; also Sumner and Graham Aves.—north to west city limits.

Cal., Redlands—City Trustees have decided to replace with concrete all cobblestone curbs and gutters.

Cal., Sacramento—Calif. State Hwy. Comn. has notified the Supvrs. of Riverside, San Bernardino, Orange, Imperial and Los Angeles Counties that plans for 30 miles of state highway to fill gap in Imperial Valley Hwy., Riverside and San Bernardino Cos. are practically completed and bids will be taken soon.

Cal., Sacramento—Chamber of Good Rds. Assn., will consider the constr. of 8 miles of new highway to connect capital city with new trade town in Sutter Basin Dist. Geo. F. Maddock, Gen. Mgr. of Sutter Basin Co. San Diego, Cal.—$80,000 bonds voted to pave 1.9 miles Tide Street; concrete base. F. Rhodes, City Engr. San Diego County voted $2,300,000 bonds to pave 135 miles of road. J. B. McLees, Clk.

Cal., San Luis Obispo—County having plans prepared for improving 2 miles Paso Robles-Cambria Road; also continuing State Hwy. thru Arroyo Grande and paving same with cement. Abt. $8,000 and $28,000, respectively.

Colo., Brighton—State Hwy. Comn. has included in its 1920 program of road impvts. an item of $146,000 for bldg. 6½ miles cement rd. betw. Brighton and Fort Lupton.

Ida., Lewiston—City Council has decided to proceed with the impvt. of District No. 12. City Atty. instructed to draw up Resolution to that effect. Est. cost of work, $54,000.

Ida., Waha—Commrs. Waha Tammany Hwy. Dist. plan to pave 7 miles Waha-Tammany Hwy. to Lake Waha, gravel or waterbound macadam. Cost will exceed $75,000. G. W. Wallace, Lewiston, Commr.

Ill., Benton—City contemplates paving abt. 100,000 sq. yds. streets. Abt. $500,000. C. B. Mantz, City Engr.

Ill., E. St. Louis—Resolution adopted by Bd. Local Impvts. providing for repaving 10th St.,—Broadway to State Street. Plans call for widening street to 41 ft. betw. Missouri Ave. to State St. Board also has under consideration plans for paving 10th St.,—Broad to the Free Bridge and from State St. north to the limits. Asph. wearing surf. on 7-in. conc. foundation is plan provided.

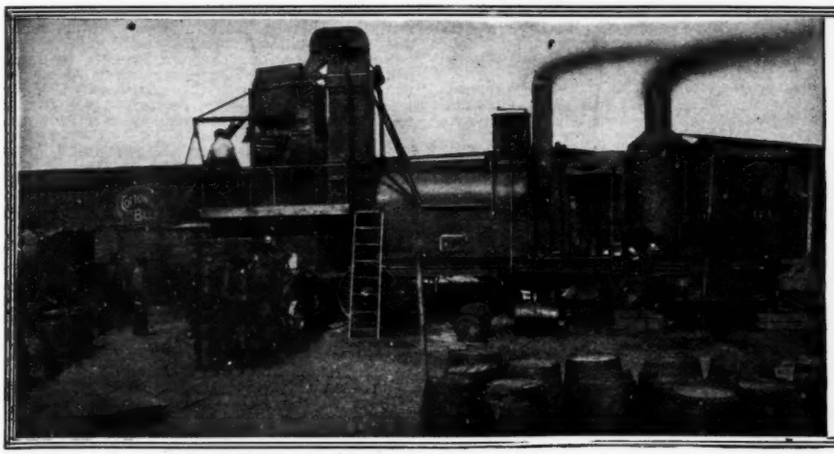
Ill., Rockford—Estimated cost of paving with brick 7th Street—14th Ave to 23rd Ave. is $66,200. Because of inability of the Bd. Local Impvts. to secure bids on paving the street from Railroad Ave. to 23rd Ave., the Board will make separate impvts. out of the job. Est. on brick stretch from Railroad Ave. to 14th Ave., is $53,650, bringing total estimated cost of the improvement up to $119,850.

Ill., Waukegan—Board Local Impvts. will endeavor to get paving program in shape so that work can be started early in Spring. Following is list of brick pavements which are to be put down in 1920: Center St. and Oakley Ave., $16,446; Fourth St.,—County to Hickory—$14,936; Belvidere and S. Jackson Sts., $60,980. Following is list of concrete pavements: Cummings Ave.—McAlister to Jackson—$27,420; Browning Ave.,—Sheridan to Clinton—$6,617; Utica, Liberty, McKinley, Ravine, George, and Caroline, $69,471; Porter—Ash to Poplar; Poplar—Porter to Myrtle; Seward—Ash to Poplar; Center—Grand to Poplar; Ash—4th to Ridgeland; Messina—North to Ash; Ridgeland—North to Ash, $61,685; Eighth—Sheridan to Lincoln and Lincoln—10th to Himholz, $57,687; Eighth St.,—Lincoln to Jackson; Ninth—Lincoln to Jackson; Jackson—10th to Cummings; Victory—10th to 7th, at $54,161.

Ind., So. Bend—Lincoln Hwy. in Noble County—Stone's Hill on Cromwell brick rd. south of Ligonier, to Noble-Allen County line, may be paved next Summer. Assurance given J. C. Kimmell that bids on the impvt. in Noble County will be invited so that active work can begin by April 1st.

Iowa, Knoxville—Bond issues for paved roads, recently authorized in this state, will total $18,475,000 and those proposed amount to $4,500,000, according to summary of state and county bond issues made by Portland Cement Association of Chicago. Counties listed as having bond issues for roads are as follows: Black Hawk, $1,500,000; Cerro Gordo, $750,000; Clay, $800,000; Clinton, $1,000,000; Floyd, $1,000,000; Greene, $1,000,-000; Hancock, $1,000,000; Kossuth, $1,500,-000; Lyon, $1,250,000; O'Brien, $1,500,000; Polk, $2,000,000; Scott, $2,000,000, and Woodbury, $2,000,000.

Kans., Atchison—Resolution adopted by



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constr. of 19 miles hard surfaced road between Atchison and Effingham. Road will be built of rein. concrete slab and bids probably asked in February.

La., New Orleans—About 70,000 sq. yds. of wood block paving will be put down during 1920 here; work to begin early in 1920. Paving and repaving program includes larger amount of creosoted wood block paving than any preceding program has ever done.

Maine, Augusta—$4,000,000 will be available for road construction in this state during 1920. It is expected 150 mi. of new state hwy. will be constructed. Paul D. Sargent, Chf. Engr. Projects are being put into shape and presented to Fed. Govt. for approval as fast as possible, as Hwy. Comn. desires to let contracts at as early a date as work is in a condition to let.

Minn., Duluth—Four W. Duluth thoroughfares will be paved during 1920, according to report made by J. A. Farrell, Commr. Pub. Wks. Proposed paving projects are: Grand Ave.—59th to 84th Aves.; 8th St.,—Central to 60th Ave.; Raleigh Street—Central to Grand Aves. and 63rd Ave.—Roosevelt to Pulaski Streets.

Minn., Madison—Surveys being made for 40,000 sq. yds. paving. Bids will be received on all types of pavement. Abt. $200,000. J. W. Shaffer & Co., New York Life Bldg., Minneapolis, Engrs.

Mich., Charlotte—South Main Street in Charlotte will be paved from present so. end of pavement past the fair grounds and Bennett park to the bride over Battle Crk. at city water works. Brdg. will also be built. Mr. Fowler, Chrmn., Eaton Co. Rd. Comn.

Mich., Detroit—Park Blvd.—Adams to Woodward Aves.,—will be widened 8 ft. Dept. also authorized to widen Second Ave. Henry St. to Grand River Ave. to 100 ft. and Henry St. to 80 ft. betw. Grand River and Second.

Miss., Jackson—Sharkey County, Miss. is now preparing to construct 13 miles of concrete road at cost of $450,000. County planning bond issue of $650,000 in order to have complete system of roadways thru county from north to south and connecting with the Delta Hwy.

Minn., Montevideo—Plans being prepared for 53 blocks of paving. Engrs. Jno. W. Shaffer & Co., New York Life Bldg. Minneapolis, Minn. Various types. B. O. Bonn, City Clk.

Mo., Bolivar—State Hwy. Comn., Springfield, Mo. has approved estimate by H. P. Moberly, Div. Engr., for improving 138 mi. of state rds. in Polk County, $585,672.

Neb., Omaha—City Commr. Towl and City Engr. Bruce have reported to Council their approval of petition for the regrading and repaving of St. Marys Ave.,—east curb line of 17th Street to east curb line of 24th Ave. Work will involve expendt. of abt. $200,000.

N. J., New Brunswick—$3,000 bonds voted to grade Codwise Ave.; $59,000 to pave Rutgers St., Livingston, Commercial and Codwise Ave., sheet asph.; $63,000 to pave Remsen Ave., Townsend, Comstock, Condict, Brown, Hamilton, French, Alexander and other streets, Warrenite bitum. conc., and $8,000 to repave Fitzpatrick and Paterson Sts., Warrenite bitum. concrete.

N. Y., Brooklyn—Board granted authorization for local impvts. in Queens to cost $168,800. Work includes regulating, grading and paving; also construction of sewers.

N. D., Minot—State Highway Commission will make road improvements—511.6 miles. Est. cost $1,370,816. Helen L. Scofield, City Treas.

Ohio, Findlay—County Commrs. have decided to improve the Findlay-Carey Road at cost of $70,000.

Ohio, Lakewood (Cleveland, P. O.)—City plans to grade, drain, curb and pave 11,-250 ft. Hazelwood, Wyandotte, Richland and Lakeland Aves., asph., conc., bitum., brick blk. of macadam. Abt. $50,000. E. A. Fischer, Lakewood, Engr.

Ohio, Toledo—Sandusky County Board of Commrs. will present plans for 11 miles of new paving in Sandusky Co. to Hwy. Comn. in Columbus this week. 6 miles of Maumee pike betw. Hessville and Woodville included.

Ohio, Wooster—Seven and a half miles of Three C Hwy., Holmes Co., will be constructed in 1920. Paving will extend east from Loudonville. Plans being made by Wayne County Commrs. to pave entire route of road betw. Wooster and Shreve next year.

Ore., Grants Pass—Bldg. of hwy to Josephine County caves is to proceed without further delay. Forestry Dept. has approved project and issued instructions covering location survey prelim. to letting contract as soon as grading is possible in the Spring.

Ore., Tillamook—At meeting of Bayocean Rd. Dist. it was decided to vote special bond tax of 10 mills. Funds will be used in bldg. Bayocean part of road which County will complete to that place next year, budget providing for $24,000.

Pa., Monroe—City plans to grade and pave 20 miles of road on Pocono Mountain, 16 ft. wide, water bound macadam on conc. base. Abt. $500,000.

Pa., Philadelphia—Burlington city authorities will co-operate with county and state in extending proposed concrete road entering city by Jacksonville pike, thru Federal street to High.

S. D., Mitchell—During 1920 City plans to spend more than $800,000 in bldgs., street impvts., walks, water mains, sewers and other public improvements.

Tex., Eastland—Eastland County Commrs. will ask bids about April, 1920, for construction of 210 miles of road; conc., or brk. and asph.-macadam. $4,500,000. C. R. Starnes, in charge. W. R. Eccles, Engr.

Tex., Woodville—Bids latter part of Jan. for constr. of 265 miles rds. and bridges in Tyler County; $800,000. Hess & Skinner, Engrs.

Wis., Port Washington—City plans to pave, grade and drain 2.8 miles Lake Shore Road, 18 ft. wide, rein. conc. Abt. $90,000. J. H. Mueller, Thiensville, Engr.

Wash., Seattle—Adams County will undertake the constr. of more than 92 miles of highways in 1920, according to estimate prepared by F. R. Hewitt, Engr., Adams Co.

Wash., Spokane—Total of $11,207,287 will be expended for road impvt. in 15 counties in eastern section of state, during coming two years. Of this amount $1,000,000 will be spent in Spokane County, this total including the twp. funds.

W. Va., Logan—Bids will be asked about March 1st by Logan County Commrs. for grading and hard surfacing 50 miles of rds.; constructing 4 brdgs. Est. cost abt. $1,000,-000. J. N. Smith, Co. Engr. W. F. Farley, Pres. of Comn.

Wisconsin, Madison—Recommendation by Street Comn. for impvt. program for 1920 calling for expendt. of $412,695, which includes paving 25 streets unanimously adopted.

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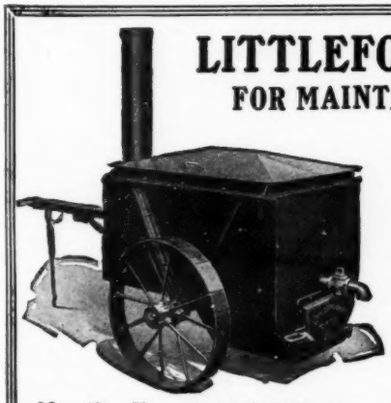

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No. 48. Tar and Asphalt Heater.

Wis., Cumberland—Barron County Board of Supvrs. has appropriated $135,000 for making and maintenance of good roads within county.

SEWERAGE AND SEWAGE TREATMENT.

Ala., Dothan—$40,000 bonds voted for construction of sewer system. R. W. Lisenby, Clerk.

Ark., England—Impvt. Dist. formed for purpose of constructing sewer system for town. District will cover entire town and work will cost about $50,000. Bonds have been sold.

Ark., Dermott—Commissioners appointed by City Council for district to extend sewer system. Ford & McCrea, Little Rock, Ark., Engineers.

Cal., Anaheim—Anaheim and Fullerton are planning an outfall sewer to Pacific ocean, and this system will do away with the sewer farms of these cities. Preliminary steps toward project have been taken by councils.

Cal., Huntington Beach—Sumner & McMillan, engineers, H. W. Hellman Bldg., Los Angeles, prepared plans for sewers in alley between California and Huntington avenues, requiring 2,090 ft. 8-in. pipe. Estimated cost, $3,600.

Cal., Los Angeles—Harbor Commission filed with City Clerk formal notification that it is willing to pay from its harbor revenue fund assessments for construction of sewer system on Terminal Island.

Fla., Panama City—City contemplates construction of 18 to 24 in. storm sewer; $20,000; 8-in. sanitary sewer, $10,000. F. S. Parrigan, Civil Engineer. Prelim. estimates prepared. Vote in January on $30,000 bonds.

Fla., St. Petersburg—$250,000 bonds voted by city for sewer system extension.

Ga., Grantville—City has voted $18,000 bonds for improvement of sewer system. T. M. Zellars, Mayor.

Idaho, Lewiston—City Engr. Burns submitted preliminary plans and estimates for sewer system to serve University Addition, in southern section of city. Engr. Burns finds that the cost would be about $13,345.

Ill., E. Moline—City plans to build 10,000 ft. 36-84 in. sewers in various streets. About $230,000. W. L. Barnes, City Engineer.

Ill., Streator—Plans for proposed comprehensive sewer system here have been completed by G. E. Clausen, Consit. Engr., and have been presented to State Engrg. Dept. for approval. It is hoped to have everything ready for letting contract during first two or three months of 1920.

Ill., Wheaton—City contemplates building sewage disp. plant, including filter beds, $57,573; also sewer and outlet drain, $20,000. L. T. Ruddock, City Engr.

Ind., Indianapolis—Three impvt. resolutions confirmed by the Board of Public Works, providing for main drain in Barth avenue, from Orange street north 240 ft.; local sewer in Holmes avenue, 100 ft. north of St. Clair street to 78 ft. south of Tenth street, and for local sewer in first alley west of Meridian street from main sewer in South street to 185 ft. north.

Ia., Duncombe—City will ask bids this winter for constr. of sewer system. Plans under way. C. H. Currie, Engr., W. Mallinger, City Clerk.

Mass., Woburn—Buckman Tanning Co. having prelim. plans prepared by Vaugh & Meyer, Engrs., Security Bldg., Milwaukee, Wis., for rein. conc. sewage disposal tank and reclamation of tannery sludge, at about $15,000.

Mich., Adrian—State Board of Charities, Lansing, having tentative plans prepared for trenching and laying vitr. crock sewerage system in grounds of Industrial Home for Girls here. About $20,000. A. Jewell, care State Board of Health, Lansing, Engr.

Mich., Adrian—Resolutions passed providing for 8-in. sewers on Lawrence street, Center street west to Raymond Garage & Equipt. Co.; on West Maumee street, beginning of Williams street, to city limits.

Mich., Grand Rapids—City Mgr. Fred Locke has requested City Engr. G. J. Wagner to make survey of sewer system through city and make recommendations for handling of storm water.

Mich., Grand Rapids—Section of city south of Burton street is to have a sewer system. Estimated cost, $150,000. City Engr. G. J. Wagner has drawn the plans for the system, to be known as the south end sewer system No. 2. Est. cost of sanitary sewers for system is $125,000; $25,000 for storm basins.

Mich., Marysville—City plans to install complete sewerage system, to include sewage treatment works, trunk sewers and laterals. Smith, Hinchman & Grylls, 710 Washington St. Arcade, Detroit, Engrs.

Mich., Saginaw—Council having plans prepared by H. H. Eymer, Engr., City Hall, for constr. of sewers in Bay and Ames streets, State street to north city line, Charles street, Monroe to Cooper streets and Alger street, Holland to Ruckle streets, involving 12-24 in. vitr. crock pipe. About $30,000.

Minn., Benson—Plans under way for constr. of storm sewers. Est. cost, $80,000. Bradley Engrg. Service, Webber Bldg., St. Cloud, Engrs.; L. M. Pederson, City Clerk.

Minn., Duluth—Norton Fairmont Park Impvt. Club has petitioned City Commrs. to construct sewer system in that district next spring. J. A. Farrell, Commr.

Minn., Ellsworth—Plans being prepared for building sewerage system. About $40,000. Druar & Smith, Globe Bldg., St. Paul, Engrs.

Minn., Paynesville—Plans in progress for sewer system. Bradley Engrg. Service, Webber Bldg., St. Cloud, Engrs; A. M. Abbott, City Clerk.

Minn., West St. Paul—City contemplates installing 8 or 10 blocks sewer in spring. City Clerk Frank Amos, City Hall, W. St. Paul.

Mo., Cameron—New sewer district, accessible to property owners in the northeast section of city, is to be organized, and Council has arranged to have bids submitted for constructing the septic tank which will be made of concrete.

Mo., Kansas City—Bids will be asked in January by Board Public Works for construction of sewers, $75,000; disposal plant, $35,000. Paul A. Hartung, Engr.

Mo., Mexico—$25,000 bonds carried for purpose of building modern sewage plant.

Neb., Crete—City plans to construct sewers in various streets. About $73,000. Engineer not selected.

N. J., New Brunswick—$25,000 bonds voted to construct surface draining sewers in various streets.

N. C., Forrest City—City considering installing sewerage system. About $25,000. J. B. McCrary Co., Atlanta, Ga.

N. D., Minot—City will construct sewage disposal plant next spring; $185,000. W. T. Shaw, Pres. Board of Commissioners.

Ohio, Columbus—Prelim. steps toward organization of central part of Franklin county into a special sewer district with Columbus as the center and as the outlet for all sewage in the district were taken at meeting of the Engineers' Club. Plan includes city, Worthington, Grandview Heights, Upper Arlington, Linden Heights, E. Linden and Bexley.

Ohio, E. Liverpool—Four petitions for sewer improvements being circulated in vicinity of Seventeenth and Commercial streets, and are being freely signed by residents.

Ohio, Hamilton—Impvt. of Hamilton Park with sanitary sewers and house connections has been ordered by Council. Streets to be improved are: Dick avenue, Cereal to Highland avenues, Virginia avenue, Edgewood to Gray avenues, Marcia avenue, Virginia avenue to Highland avenue, and Emerson avenue.

Ohio, Lakewood (Cleveland P. O.)—City plans to construct 9,000 ft. vitr. and segm. blk. sewers in Edgewater Drive, Webb Rd. to Sullivan Park, and Franklin avenue from Contant to Highland avenues; abt. $35,000. E. A. Fisher, Lakewood, Engr.

Ohio, Sandusky—Plans will be submitted to State Board of Health for proposed Mittiwanga sewage disposal plant.

Okla., Chandler—Plans and specfs. being revised for Lateral Sewer District No. 2 by V. V. Long & Co., Consit. Engrs., 1300 Colcord Bldg., Oklahoma City.

Ore., Portland—Resolution adopted by Council to build L. 33rd and Stanford streets sewerage system; vitr. or cem. pipe, with necessary lampholes, manholes, catch-basins, sewer service pipes and branches. Estimated cost, $229,646. O. Laurgaard, City Engr.

Ore., Portland—City plans to build sewerage system in L. 38th and Knight streets, vitr. or cement pipe, $13,115; improve E. Tenth street (grading, draining, etc.). C. Laurgaard, City Engr. City also plans to build vitr. or cement sewers, manholes, lampholes, catch-basins, serv. branches and trunk lines in portions of E. 57th street, $12,928; E. 54th street, $6,968; Ravenswood Dr., $2,246; Williamette Blvd. and Rens street, $1,933; Albina avenue, $25,294; E. Seventy-second and Taylor streets, $8,991; E. Fifty-eighth street, $1,357; E. Thirty-eighth street, $6,607; north line Sandy Blvd., $5,624; E. Fifty-third street, $6,048, and Nevada street, $945.

Ore., Portland—Commr. Barbur has announced plans for sewer construction to cost $135,130.

Ore., Seaside—Resolution adopted by Council to extend sewer system in side streets; vitr. or cement pipe. About $15,000. E. S. Abbott, Aud.

Pa., Butler—City Council expects to submit permanent sewer plans within a short time for the College Hill and Pleasant View Districts to State Dept. for approval. Plans for the Park View District sewer have been submitted.

Pa., Harrisburg—City having plans prepared by M. B. Cowden, City Engr., for sewer running east from Derry & Twenty-first streets to eastern city line, south to Phila. & Reading R. R., thence west to Mish's Run; second sewer following Asylum run from North and Cameron streets east to northeastern part of city. About $100,000.

Pa., Hazleton—$500,000 bonds will be used for construction of sewers and extension of street paving.

S. C., Pickens—$55,000 bonds voted by city to construct sewer and water systems. Sam B. Craig, Mayor.

Wash., Spokane—North Side residents who protested the building of a trunk sewer on North Post street are reconsidering their action, and the project may go through.

Wash., Oakesdale—Plans for construction of sewer system endorsed by City Council. C. H. Green Co., Engrs.

Wash., Toppenish—Ordinance passed by Council for trunk sewer system designed to serve the Swansey and Woodlawn additions. Will connect with existing sewer at South L street. Total length will be in excess of 6,000 ft., and sewer pipe will vary in diameter from 8 ins. to 15 ins. at point of intersection with outlet to present system.

Wis., Kohler—Preliminary surveys being made for sanitary sewerage system. About $75,000. J. Donohue, York Bldg., Sheboygan, Engr.

Wis., Wauwatosa—Milwaukee County Bd. Administration plans to construct extension to sewage disposal tank, involving 200 cu. yds. rein. conc. and 750 ft. 15-in. vitr. pipe. About $30,000. W. C. Shields, 1201 Hartford Bldg., Chicago, Ill., Engr.

WATER SUPPLY AND PURIFICATION

Cal., Los Banos—City has purchased W. San Joaquin Valley Water Company's plant and plans to move same, install tank, tower and filter, and construct mains and fire hydrants.

Cal., Sacramento—City having plans prepared by G. J. Calder, Constr. Engr., for building water filtration plant. About $1,500,000. C. G. Hyde, Consit. Engr.

Cal., San Diego—$1,000,000 voted by city for construction of Barret dam, probably single arch cyclopean masonry type. Work will probably be done by day labor under supervision of H. N. Savage, City Hydr. Engineer.

Cal., San Francisco—Port Costa Water Co. contemplates improvements to cost $100,000.

Cal., Calexico—Bonds to amount of $30,000 voted to construct municipal water system and $30,000 bonds voted to complete the water works supply system, cement the canal and acquire rights of way.

Colo., Colorado Springs—El Paso Co. contemplates improvements to water system. involves expenditure of $16,000.

Idaho, Rathdrum—City plans to improve water works system, including laying of 2,640 ft. 8-in. pipe, including construction of pumping plant and well. About $12,500. Engineer not selected.

Idaho, Ashton—$50,000 bonds sold to improve water works system.

Idaho, Ashton—Fremont-Madison Reservoir Company, H. G. Fuller Vice-Pres., plans immediate construction of reservoir at Fall River Meadow near the National Park.

Ia., Arnolds Park—M. I. Evinger, Engr., 222 Davidson Bldg., Des Moines, retained by city to prepare preliminary surveys and submit estimates of cost for water works and sewerage systems. G. H. Sherburne, City Clerk.

Ia., Cherokee—Ready about March 1 for water works system. Owner State Hosp. for Insane, Des Moines, and State of Iowa under Board of Control, State Institution. Plans under way. State architect to take bids. Engr., W. E. Buell, 229 Davidson Bldg., Sioux City; 10,000 c. i. pipe line; 8-in. pump house, 300,000-gal. conc. reservoir and pumping machinery; $70,000.

Ia., Quimby—Plans being drawn for water works system. Engr., C. H. Currie, Webster City, Ia.; $16,000. O. F. Parker, City Clerk.

La., Lake Arthur—City will install water works; $50,000 bonds voted.

La., Monroe—Plans being made for water works improvements, including about 18 miles cast iron mains, to 18-in. diam.; filtr. plant, 3 million capy.; centrif. raw-water pumps; service pumps, 4 million gals. capy. Approximate cost of water and

light plant, $450,000. Walter G. Kirkpatrick, Consulting Engr. and Director of Pub. Works.

Mich., Detroit—Estimates of cost of additional machinery to be used by the Water Board in gigantic water main extension program for 1920 filed with Mayor Couzens. It is planned to purchase 5 new trench excavators, concrete breaker used in opening excavations on paved streets, back-fillers, tractors and graders, together with cranes for handling large pipes and pumps; also portable lighting plant. Equipment estimated to cost $101,650. Pipe and other construction material will cost $1,001,385, which with new machine shop and storage yard equipment will make total expenditure of Board $1,884,908.

Mich., Ironwood—Recommendations of Alvord & Burdick, San. and Hydr. Engrs., 8 S. Dearborn street, Chicago, Ill., adopted. Water supply will come from Spring Creek area. Estimated cost of plant, $435,000.

Mich., Pontiac—Engr. C. W. Hubbell, Detroit, authorized to proceed with plans, profiles, etc., for water works improvements. Proposed extension will cost about $500,000, divided as follows: $404,000 for filtr. plant.

Minn., Chisholm—Water mains on Lake street rapidly deteriorating and will have to be repaired this spring. Estimated cost, $7,250 for material and labor.

Minn., Clearwater—Bradley Engrg. Service, St. Cloud, Minn., now preparing plans for $60,000 water works system, including tank and pumps. W. P. Pinneo, City Clerk.

Minn., Lake Venton—Plans being prepared for water works extension by Bradley Engineering Service, Weber Bldg., St. Cloud, Minn. Estimated cost, $20,000. E. M. Kimball, City Clerk.

Mo., Kirksville—Plans being prepared for improving water works system, to include installation of one 10 h. p. water tube boiler, two 10 h. p. oil engines, two 60-gal. per min. centrif. pumps, etc. About $30,000. W. B. Rollins & Co., Ry. Exch. Bldg., Kansas City, Engrs.

N. J., Asbury Park—Plans prepared for installation of new equipment at city water station, including system of oil burning engines. Water Supt., Robt. Bartley, Jr. Estimated cost, $112,000.

N. D., Dunseith—State Board of Control, Bismarck, preparing plans for water softening plant for State Tuberculosis Sanitarium here. About $5,000.

N. D., Ray—Plans nearing completion for $70,000 water and sewer system. Water system includes two wells, erection of power and pumping station, 2 electric driven engines and pumps, 100-ft. tower and 50,000-gal. tank; $45,000.

Ohio, Canton—R. Winthrop Pratt, Cleveland, Consulting Engr., has plans for proposed 15,000,000-gal. equalization basin to be constructed at northeast end field. Ordinance passed to appropriate 9 acres of land lying north of Oakwood road, north of city, as site for the basin. Estimated cost, $280,000.

Ohio, Cincinnati—City plans to construct water mains in Montgomery Pike, Kennedy Heights, westwardly; also through Mill Creek Valley and from Western Hill Station to College Hill. Estimated cost, $720,000; install new boilers, pipe, etc., in Main River Pumping Station and boiler equipment in Western Hills Station, $380,000. F. Krug, City Engr.

Ohio, Rocky River—City will ask bids in spring for building 4,000 ft. 6-in. water mains in Telbir and Shoreland avenues. About $11,000. E. H. Arnold, Rocky River, Engineer.

Okla., Oklahoma City—Water main extensions to East Capitol Hill is part of program sponsored by Mayor Walton, following Commission's decision to purchase about $65,000 worth of pipe. About 1,200 tons of pipe will be bought for extending service to districts that have been longest without it; $125,000 bonds voted for water improvements.

Okla., Pryor Creek—Preliminary report in progress for improvements, including water purification plant, pumping station and transmission line. V. V. Long & Co., Consltt. Engrs., 1300 Colcord Bldg., Oklahoma City, just selected.

Ore., Baker—Preliminary plans being prepared for building concrete reservoir and wood or cast-iron pipe line system for taking water from Sam Springs to new natatorium. About $5,000. W. W. Gardner, Mayor.

Ore., Echo—Water system to be improved at once by substitution of iron mains for the old wooden pipes. Order placed for the pipe, subject, however, to cancellation in the event that the tax levy is not adopted.

Ore., Knappa—Preliminary plans being prepared for gravity water system, involving 3.5 miles cast-iron water mains and branches. About $8,000. A. Lechner, Agt.

Tenn., Memphis—Old town of Binghamton has become part of this city and will be supplied with water from city's water system.

Tenn., Pulaski—Klyce & Kackley, Nashville, Engrs., retained by City Council to make investigations and submit report on improving water supply system.

Tex., Harrisburg—City Engineer, Houston, will design and supervise work of installing water works system at Harrisburg.

Tex., Port Arthur—City considering improvements to water supply, including pipe line and flume to be built from the Sabine River, near Orange, to Port Neches, and from there into city through city's 27-in. redwood pipe line.

Wash., Anacortes—Resolution passed by Council providing for first step in giving city an improved water system. Resolution provides for installation of 10-in. main from Thirty-eighth street along Commercial avenue to Seventeenth street, where new main will join the 8-in. main already in existence. Estimated cost of improvement, $12,000.

Wash., Seattle—City will construct new 50,000,000-gal. concrete reservoir at Volunteer Park at estimated cost of $410,000. L. B. Youngs, Supt. of Water; Mr. Dimock, City Engr.

Wash., Selah—General plans for water system for town adopted at meeting of City Council. Specifications submitted by two engineers, N. A. Gilman, Yakima, and representative of O. H. Green & Co., Spokane. Reservoir will be constructed on hillside, 500 ft. or more above level of town.

Wash., Yakima—City Engr. Chas. F. Wilson and staff are giving considerable attention to proposed water system and irrigation system to be installed on east side of city. Estimates of work being prepared, and as soon as these are completed calls for bids will be issued.

BRIDGES AND BUILDINGS

Ark., Searcy—Plans prepared for construction of 9 steel bridges in White county. Work will be done in 1920. F. O. White, Co. Judge.

Cal., Huntington Beach—Sumner & McMillan, Engrs., H. W. Hellman Bldg., Los Angeles, submitted to city trustees plans for conc. culvert 3 ft. wide and 1 ft. deep, to be constructed at Main street and Ocean avenue.

Conn., Bridgeport—City considering expenditure of $100,000 to repair present Steeplechase Island Bridge over Johnson Creek.

Fla., Tallahassee—State Rd. Dept. soon to let contract for building 388 ft. brdg., 18 ft. rdway, 6 ft. walk, over Blackwater River at Milton, to have 4 steel girder approach spans and steel bascule left span, etc. C. A. Browne, Tallahassee, Engr.

Ga., Americus—Sumter and Crisp counties may join in erecting bridge over Flint River on highway between Americus and Cordele, at the Huguenin Ferry site. Superior Court has recommended constr. of bridge, and Crisp county already employed engineer to prepare estimate.

Ga., Augusta—South Carolina and Georgia having preliminary sketches made by H. C. Orr, Bridge Engr., State Hwy. Dept., Columbia, for 800-ft. steel bridge, concrete piers and abutments between Aiken county, S. C., and Richmond county, Ga. About $175,000.

Ind., Attica—County Council of Fountain considering question of making appropriation for construction of new bridge over the Wabash River at Attica. Mr. Titus, Engr., of Indianapolis, has been retained to prepare plans and specifications and furnish estimate of cost of a new reinforced concrete bridge, and his estimate on entire cost of brdg., including the two approaches, was $282,741.

Mass., Chelsea—Dept. Pub. Wks. plans to construct concrete and steel bridge. About $500,000.

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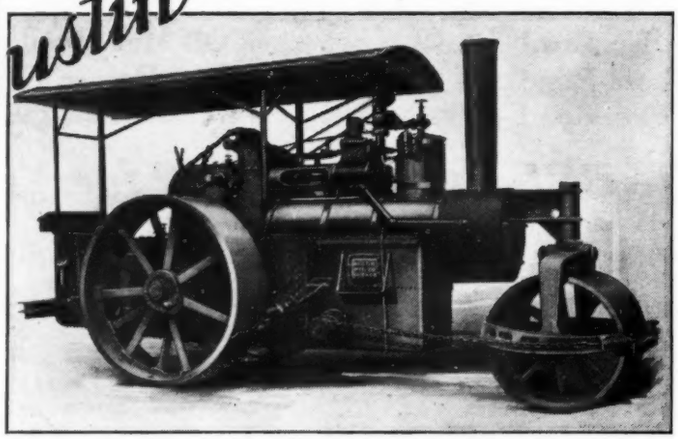

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